consulting engineer

.....a new concept in one century

Engineered Sanitation

E. SHERMAN CHASE, one of the pioneer practitioners of sanitary engineering in this country and a senior partner in the Boston firm of Metcalf & Eddy, has a keen eye for history. There is the spectacular human drama of the sanitary engineer's conquest of the plague diseases; the pathetically

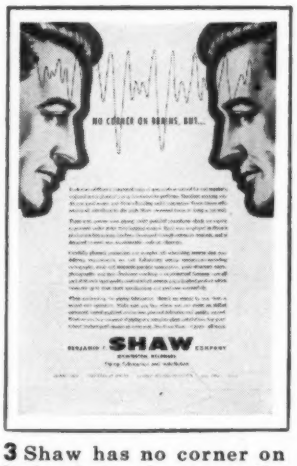
(Continued on page 8)

Shaw's 8 point production story is your piping fabrication success story

Whatever your piping fabrication and installation problem—processing plant, power plant, steel mill, refinery, or industrial plant—Shaw employs this vital 8-point production method to assure you a job well-done from inception to completion, at lowest cost to you.

1 Competent Shaw engineers plan efficient, economical procedures for your piping project from inception to performance-ready installation

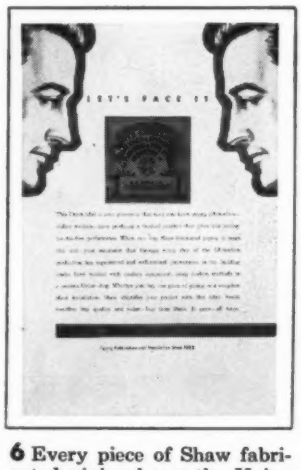
2 Shaw gives you all the fabricating services necessary for dependable, quality piping that conforms exactly to the specifications for your project



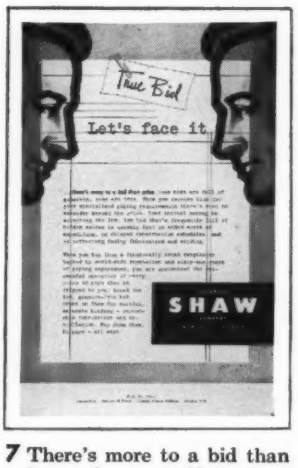
3 Shaw has no corner on brains, but each man on the company's team of specialists is trained for the phase of piping fabrication he performs

4 Behind the trained and tireless eyes of Shaw technicians is your assurance of quality finishing in the fabrication of your piping project

5 You spend your piping dollar for all it's worth when you buy from Shaw, where your requirements are accurately translated into minute details



6 Every piece of Shaw fabricated piping bears the Union label—your assurance that your job has been produced by experienced journeymen



7 There's more to a bid than price, and you avoid the low, gimmick-type bid when you count on Shaw for careful, accurate bidding on your job

8 "Look ahead!" is the byword of every phase of Shaw production—modern facilities, latest production-line techniques, time-saving equipment

Whether your piping project is large or small, you buy dependable, quality fabrication and installation when you place your contract with Shaw. Buy from Shaw—it costs no more and pays all ways.

SHAW
COMPANY
Wilmington, Delaware

VOLUME 4

NUMBER 6

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420 Main Street, St. Joseph, Mich.

consulting engineer

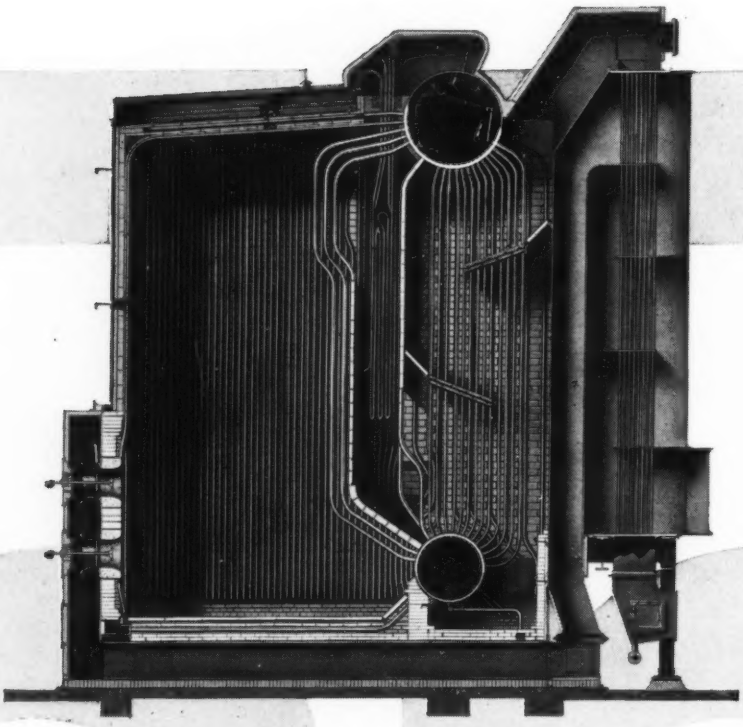
DECEMBER 1954

FEATURES

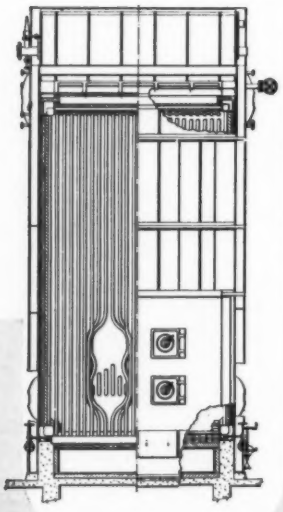
DEPARTMENTS

NBP CONSULTING ENGINEER is published monthly at 420 Main St., St. Joseph, Mich. Subscription 1 year $5.00; outside U. S. price $10.00; single copy 50c. Acceptance under Section 34.64 P. L. & R. authorized by U. S. Post Office. Form 3547 requested. BPA

THE VU-55 - -



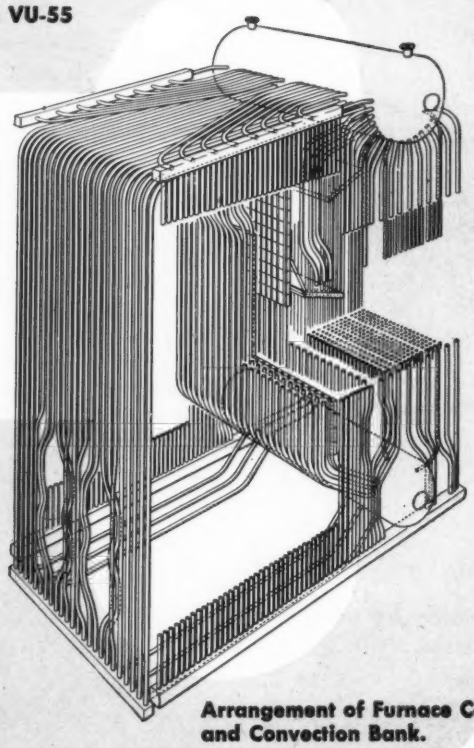
C-E Vertical-Unit Boiler, type VU-55



Front Elevation

SPECIFICATIONS

Sizes—Six sizes ranging from 50,000 to 120,000 lb of steam per hr.
Pressures—250 to 500 psi (all sizes)
Temperatures—as required up to 750 F
Fuels—oil or gas
Heat Recovery—Tubular Air Preheater



Arrangement of Furnace Cooling and Convection Bank.

A NEW MEMBER OF THE VU FAMILY

. . . for steam requirements from 50,000 to 120,000 lb per hr

One of the most important size groups of industrial boilers is that comprising capacities ranging from 50,000 to about 100,000 pounds of steam per hour.

Combustion Engineering has designed a boiler unit especially suited to the modern requirements of that capacity range. It is the Vertical-Unit Boiler, Type VU-55, here illustrated and described.

Developed with the same background of experience and engineering competence that is responsible for the service-proved success of Combustion's VU-family of boilers, the VU-55 offers numerous advantages to anyone whose steam needs fall within its application range. The more important of these advantages are:

ADVANTAGES

FURNACE ARRANGEMENT—The VU-55 is designed specifically for firing with oil or gas fuel. The furnace is high; the burners are set low in the front wall. The resultant long flame travel assures adequate mixing and proper combustion.

SYMMETRICAL DESIGN—Each transverse section through the VU-55 Boiler is the same as every other. Furnace gases flow across the surface of each section in equal amounts and at the same relative temperatures. Each section, therefore, absorbs the same amount of heat—produces the same amount of steam. Expansion of pressure parts is uniform; steam is released evenly across the length of the drum; water level is steady. Result—unit can carry high sustained demands or rapid load swings without pressure loss or effect on steam quality.

STEAM QUALITY—Equipped with a large (60-in.) steam drum, the VU-55 has generous water capacity and steam reservoir space. In addition C-E drum internals, which reflect many years of development and experience, assure high quality steam at all ratings.

HIGH HEAT ABSORPTION—Closely spaced side wall tubes (3 in. dia. on 4-in. centers) plus fully water-cooled front wall not only assure highest heat absorption but reduce furnace maintenance to a minimum.

STREAMLINED EXTERIOR—The over-all appearance of the VU-55 reflects the efforts of its designers to achieve a completely unobstructed casing while retaining adequate access wherever required and every facility for convenient operation. There are, for example, no outside downcomer tubes and ducts from air heater to burners are beneath the furnace floor.

In selecting your next boiler unit please consider this: You may be able to buy steam generating capacity for less (first cost) than you'll get with a VU-55. But you can't buy better. It's a matter of record that many — perhaps most — boiler installations cost more for the fuel burned *each year* than the *original cost* of the boiler. Consider, too, that when you buy a boiler you *live with it* for 20 or 30 — or more — years. Looks like the wrong place to select equipment on first cost alone. So — do not fail to investigate Combustion's VU-55. A qualified C-E engineer will be pleased to discuss any details with you or your consultants.

COMBUSTION ENGINEERING

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

B-777

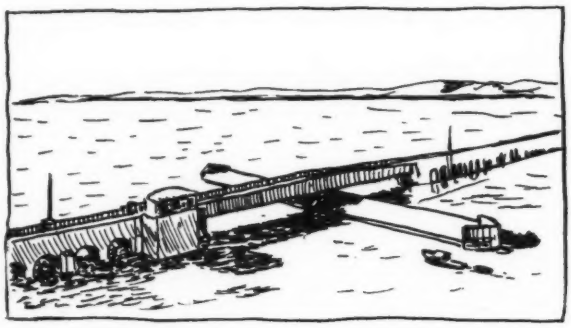
BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

Engineer's Century

—Starts on Front Cover

amusing episodes that record how the residents of London disposed of their sewage and garbage in the streets. "And when you consider the progress in a period of less than 100 years—the entire concept and science of sanitary engineering is barely a century old—the progress is truly amazing."

Why the group of pioneering chemists, biologists, and engineers whose fundamental investigations prepared the way for the application of scientific principles to water purification and sewage treatment flourished particularly in New England, is not entirely clear. But the facts are that the Lawrence Experiment Station, in Massachusetts, was the center of this activity; that the Massachusetts Institute of Technology offered the first lasting course in sanitary engineering; that the co-workers and pupils of this nucleus of outstanding men probably constitute the bulk of sanitary engineers in the U. S.



Sherman Chase was born and grew up in New England. Having indicated his interest in sanitary engineering, he was fully exposed to the influence of the dynamic personalities and developments in that area. He studied sanitary engineering at M.I.T. preparatory to becoming actively engaged in various sanitary engineering activities in the eastern seaboard states.

Leonard Metcalf, a pioneer water works engineer, and Harrison Eddy, who supervised one of the first sewage plants in this country, pooled their talents and started as the firm of Metcalf & Eddy in 1907.

With so many common interests, it seemed fairly inevitable that the ties of background, experience, mutual friends and associates, and devotion to the profession of sanitary engineering would bring together Sherman Chase and Metcalf & Eddy. He joined the firm in 1920 and became a partner in 1927.

Metcalf & Eddy specialize in civil and sanitary engineering. They owe their successful growth both to the ever increasing demand for adequate supplies of pure water and for the safe economic disposal of wastes—to the policies and practices initiated by Messrs. Metcalf and Eddy, and since their deaths, carried on by all partners.

One of the best known projects in which Metcalf & Eddy have been engaged was the design and construction supervision of the huge bomber base at Thule, Greenland, 900 miles below the North Pole. Working in the relatively unknown polar regions, without engineering precedents, required all the engineering versatility and ingenuity of the firm.

Chase, as a partner in the firm, is, of course, very much concerned with the over-all guidance and development of specific client projects. On the other hand, it has always been the philosophy of Mr. Metcalf and Mr. Eddy to encourage research and study. "We make full use of our library and research facilities and supplement these by frequent personal observation and field trips. But over and above that, it is my personal opinion that a study of the history of sanitary engineering gives us an accurate perspective for evaluating our present day problems.

"In reviewing the last fifty years, it seems that the first quarter century was devoted primarily to the problem of water purification. During the next twenty-five years we turned our attention to sewage treatment. And today, the sanitary engineer is very much concerned with industrial waste disposal and methods for clearing up steam pollution.

"What of the future? The days of conquest of disease in the United States by the sanitary engineer are in the past. However, there are many other areas of the world where, political conditions permitting, we can resume this struggle with those malignant environmental conditions that cause death and disease. In the meantime, we will continue to develop new and better techniques.

"The continued public demand to restore waterways to the maximum degree of cleanliness consistent with economic limitations will require substantial research in the field of industrial wastes treatment. The major part of the expenditures for this research will have to come from industry.

"In view of the need for conservation of natural resources, it is not unlikely that in arid regions, reclamation of sewage and other liquid wastes may be realized. Salvage of the solid constituents in sewage and wastes will require more consideration. It is possible that, in the economical development of atomic energy, ways may be found to concentrate the soluble solids of waste liquors and permit either their recovery or their cheap and easy destruction. Atomic energy may also offer a method for economic distillation of fresh water from the sea.

"The sanitary engineer's profession is as exciting and challenging as its history. All the elements of spectacular drama, death, humor, and satire are present. We can find in this history the same courage, fire, and spirit that not only helped create the profession, but that are just as necessary today."

FINDING THE ONE RIGHT GASKET

Because there are so many ways to go wrong in selecting the proper seal when fluids are confined at pressures to 4,000 lbs. . .

Because exact performance data is essential when choosing a gasket to confine fluids at temperatures up to 2000° F. . .

Engineers come to the Flexitallic "storehouse" of gasket experience on important sealing assignments. Here is performance data on Flexitallic Spiral-Wound Gaskets in thousands of applications, under the most difficult sealing conditions . . . more than 40 years of finding the right gasket for the right flange to make the proper seal.

Flexitallic Spiral-Wound Gaskets, with their uniquely resilient construction, offer the basic advantages of low seating stress and low bolt stress.

Each Flexitallic Gasket is engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler results in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125″, .175″, .250″, .285″. In diameters to 84″ O. D.

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FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

TEFLON FOR PROCESS APPLICATIONS The ideal seal for many process applications is a Flexitallic Gasket with Teflon trapped between edges of stainless steel. Ask for folder, "Teflon in Flexitallic Gaskets."

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

READERS' COMMENT

Suggestions

Sir:

We want to thank you for the September and October issues of your outstanding magazine.

We found the articles very helpful. There is certainly a need for a magazine such as yours.

You ask for suggestions. We need, urgently, reference data on contracts, estimating, bidding (for fabrication), insurance, accounting, fees, and other aspects of doing business. This material is seldom if ever furnished by other magazines, and this can be a major service by CONSULTING ENGINEER.

A. F. Gagne, Jr., P. E.
A. F. Gagne, Jr. and Associates
Binghamton, N. Y.

European Assignment

Sir:

I have often thought of how grateful I should be to receive your excellent magazine.

Upon reading of [Editor Hirschfeld's] coming assignment to Europe, I thought I would kill two birds . . . by (1) thanking you sincerely for being on your mailing list, and (2) listing some items in which I hope others will also be interested:

a. The European political setup and its effect on engineering progress. (i.e., "capitalism" vs. "socialism" vs. "communism").

b. Comparison of basic educational systems and their effect on competency of engineers.

c. Attitudes of industrial magnates and resultant comparison of industrial progress with ours.

d. Professional, economic, and social status of engineers compared with American situation.

Nicholas R. Sefing
Canton Regional Society of
Professional Engineers
Dover, Ohio

"Employment Offices"

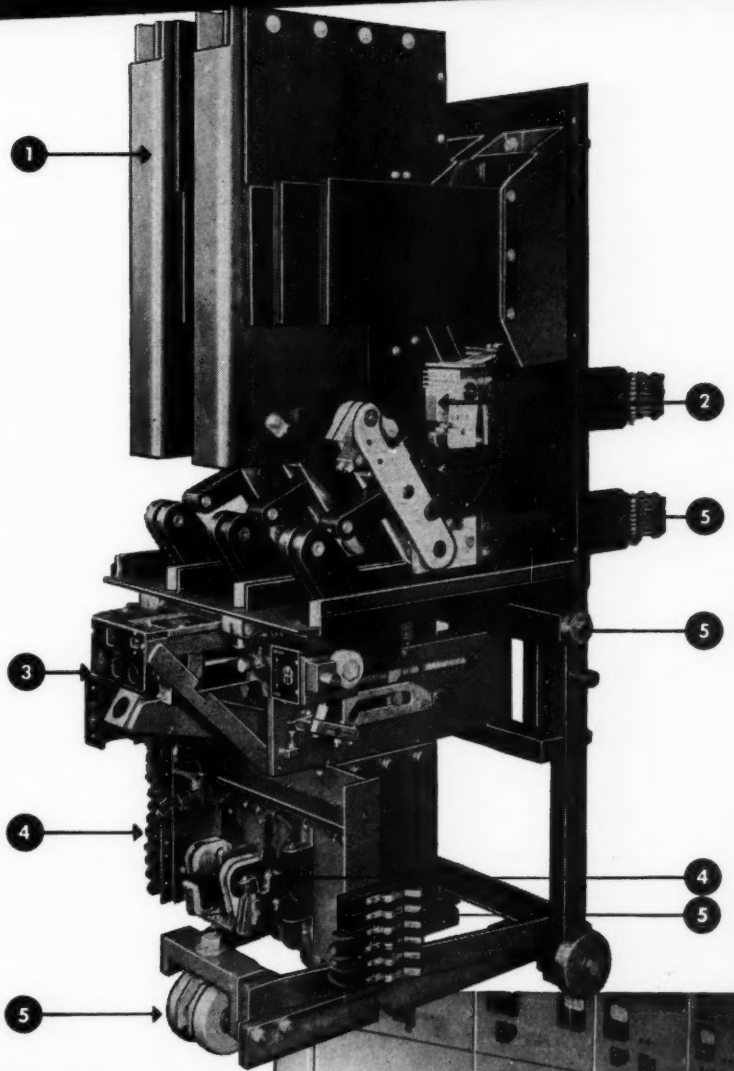
Sir:

The exploitation of engineers and draftsmen that Lasky denounces (October, pg 11) is only one aspect of the complex problems confronting us. It is rather the consequence of deplorable conditions than the cause. The very regulations enacted by the Government to prevent wartime industries from reaping excessive profits have practically set up in business a horde of commercial promoters whose only function is to secure contracts and then hire defenseless engineers for assignment. We need only scan the "Help Wanted" columns in the newspapers for the last 15 years to realize what proportions this nefarious trade has reached. These unscrupulous concerns, acting as legitimate enterprises, can hire engineers and designers to be herded by the dozens into smelly drafting rooms, or lease them wholesale to some of the largest manufacturing companies in the country.

By contrast, the small and highly coordinated engineering firm or office, acting under the direction of interested principals, no matter how competent or ethical, finds itself powerless in front of military red tape, bureaucratic indifference, and the mess of conflicting regulations of awarding defense contracts. Even if you can finally overcome such obstacles, the very efficiency for which you have worked and the consequently reduced overhead expenses are interpreted against you by inflexible regulations designed to control excess profits in machine shop or hardware types of operations.

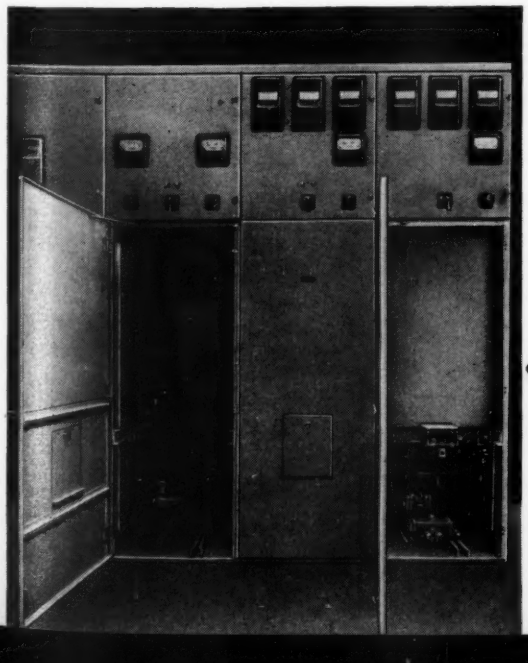
Only recently, in negotiating for a highly technical task, we found ourselves unable to satisfy a requirement that our expenses be no

engineered for • Protection • Safety • Accessibility



CHECK THIS ADVANCED I-T-E ENGINEERING:

1. **Positive arc interruption** is provided by carefully designed arc chutes, contacts, and blowout irons.
2. **Sturdy main and arcing contacts** are designed to minimize wear and deterioration due to arcing.
3. **Simplified testing** is achieved by centralizing electrical test button, manual trip button, breaker positioning device, and emergency breaker closing handle.
4. **Easy inspection and maintenance** is afforded by readily accessible secondary control relays, rectifiers, auxiliary switches, and separable contacts.
5. **Truck-type horizontal drawout** is facilitated by precision-made guide wheels, bar, and self-aligning contacts.



ACCESSIBLE COMPARTMENT DESIGN features wide-opening doors. Withdrawal of breaker closes grounded, steel shutters to protect personnel. Metal partitions completely segregate compartments. Instruments and relays are fully isolated from breakers, safe from jar and vibration—protecting against damage and false operation.

TO TEST BREAKER quickly and safely operator works through small auxiliary door—from *outside* compartment. Other safety features include complete interlocking of breaker operation, segregation of circuit wiring, proper venting of arc gases, and utilization of correct insulation materials.

less than 90 percent of our quoted fee for services. We were negotiating for a technical assignment, the cost of which represents to us many years of research, study, and experience. We were not intending to sell the Government our office furniture, stationery, or clerical costs. To circumvent this unwarranted harassing, we had to settle for a considerable lower fee and thus satisfy the Government that our "profit" was not excessive. Just how do you determine your profit when you, as an interested principal, are conducting operations and executing performance of the assignment?

Limitation to a seven percent profit on designers or engineers leased out is nothing to upset the unscrupulous operators who remain happily satisfied and well protected within the legal maximum. These absurd regulations and the rigid interpretations of the military are all acting in favor of those operators. Actually, they are allowed to reap fabulous earnings with full impunity as long as they are backed by capital enough to conduct large-scale operations. Their function is nothing more than that of high-pressure employment offices taking a cut for the life of the employment. The damage that this is causing to the standing of the engineering profession is incalculable.

M. von Ch. Barraza
East Orange, N. J.

Tremendous Job to Do

Sir:

In the October edition of CONSULTING ENGINEER you published an article "How Professional is Engineering" by C. W. Griffin Jr., (Edwards and Green).

As chairman of the Public Relations Committee of the Ohio Society of Professional Engineers, I would like to get a biographical sketch of the author and his affiliation. Would it be possible for me to get about 40 reprints of this article?

We are to have a board meeting in Columbus, also a session of my committee. There are 27 trustees representing that many chapters, five officers and seven beside myself on the Public Relations Committee.

I find your magazine very interesting and instructive. The engineers surely have a tremendous job of public relations to perform so I trust you will have many more articles on this important subject.

Arthur E. Fryer, Chairman
O. S. P. E. Public Relations
Committee

Aerial view of the Kansas City, Kansas, Works, Fairbanks, Morse & Co., 3601 Kansas Avenue.

...from Kansas City

Yes, from our new, modern-as-tomorrow works at Kansas City, we serve the world's needs for pumps.

As a major supplier of quality pumping equipment, it is particularly suitable that this new Fairbanks-Morse plant be located at an important crossroads of the world ... Kansas City. In this new plant 190,000 square feet of manufacturing space and a complete foundry occupying 150,000 square feet are devoted to bringing better service to our customers all over the world.

Modern manufacturing, development and testing equipment backed by engineering and production skills of highly trained personnel combine to produce products of unmatched quality ... in performance, durability, economy. Fairbanks, Morse & Co., Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering when you want the best

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • FARM MACHINERY • MAGNETOS

SCRAPS & SHAVINGS

NEVER BEFORE has this page been used to talk about CONSULTING ENGINEER magazine. We have always used this space to talk about some aspect of the profession.

We are breaking that rule because this is our anniversary. We are two years old. The first issue of CONSULTING ENGINEER was published in December, 1952. It was a very different magazine from the one we are publishing now. It was technical rather than professional. It did not indicate a full understanding of the problems of consultants as opposed to engineers working for industry.

This was changed quickly. Even before the second issue was published, the editors recognized that the real need was for a professional rather than a technical magazine. We saw that there were problems of professional practice that were quite different from the technical problems of engineers employed by industry. With this in mind the editorial staff established a formula for publication that has been used as a guide for the selection of article material to be published.

This formula separates the articles into two types. The first type deals with subjects of interest to the reader as a consultant—the second deals with subjects of interest to the reader as an engineer. Into this first group go all articles on ethics, fees, bidding, staff organization, sub-contracting, relations with architects and contractors, taxes, legislation, and methods of dealing with clients. These articles should be of interest to all consultants no matter how broad or narrow their field of operation. CONSULTING ENGINEER is unique in that it is the only publication carrying articles of this type written for and by consultants.

The second type of article—the article dealing with a subject of interest to our readers as engineers —has a definite purpose. We know that this magazine goes primarily to consultants who are at or near the top of their firms. These men are no longer "electrical," "mechanical," "civil," or "chemical," but are truly engineers. They must be familiar with new methods and new equipment across the whole, broad engineering profession. On the other hand, seldom are these men called upon for detailed technical computation. That work is for their assistants. Our readers are the men who make the decisions.

Keeping this in mind, we are giving some of our feature article pages to these engineering subjects.

But we handle these articles in a very special way. In editing them we try to make them understandable to any experienced engineer regardless of his particular educational background. For example, when we carry an article that describes some recent development in electrical engineering, we have the manuscript edited not only by an electrical engineer but also by a mechanical or civil. Then we can be sure that no terms, expressions, or formulas are used that are commonly known only to electrical engineers. In the same way, we have the civil articles reviewed by a mechanical, electrical, or chemical editor before publication. Using this editing process, we can be sure that our engineering articles are written in such a way that any good engineer can understand them.

By publishing in every issue several articles concerned with "consulting" and several dealing with "engineering," we present, in one package, the professional magazine for consulting engineers.

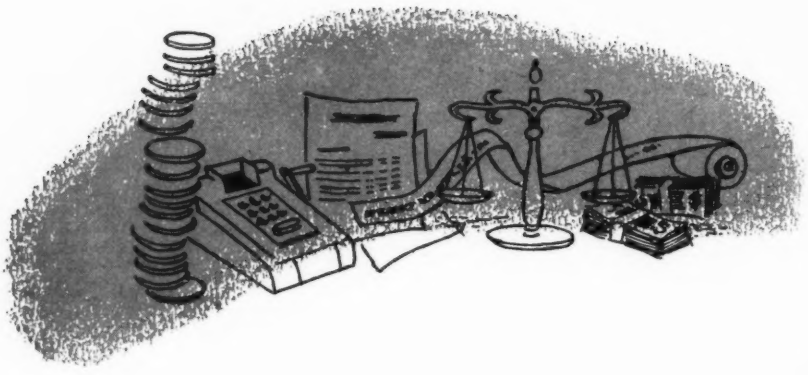
That is our formula. We think it is a good one. It may change slightly from issue to issue and from year to year, but we now think the changes will be in emphasis and will be in accord with the problems that arise within the profession. The formula, itself, is basic and sound.

Knowing the formula is one thing. Following it is another. We cannot know what our readers want by sitting at our desks and reading the mail. This past year the editors have visited with almost every regional society of consulting engineers in the country. We have called on hundreds of consulting engineers from Boston to San Francisco, from Dallas to Minneapolis. Altogether, our editors have traveled the equivalent of about twice around the world during the one year. All of this traveling was done to find out what our readers wanted in CONSULTING ENGINEER and to get the articles to fill those wants.

In the year ahead we plan to do even more visiting with readers, more working with them to make sure the information we carry in CONSULTING ENGINEER is the information they need.

You can expect us to drop by your office on one of our visits to your part of the country. In the meantime, write us a letter, and let us know how we can do a better job for you. Our editorial offices are in St. Joseph, Michigan, at 420 Main St. ▲▲

ECONOMIC NEWS NOTES



E. F. Mac Donald
INDUSTRIAL ECONOMIST

BOOMING PORTS — The unparalleled industrial growth in the Trenton and Philadelphia areas touched off by the construction of the giant Fairless Works of U. S. Steel across the river from Trenton will get a booster shot with the deepening of the Delaware River channel. The Mercer County Industrial Commission has an imposing list of firms that have indicated their interest in locating in the county as soon as ocean-going transportation is possible. The Commission stated that the list lengthened considerably immediately after President Eisenhower signed the bill authorizing the dredging of a 40-foot channel in the Delaware. The Port of Philadelphia is already booming — Army Corps of Engineers data show a tonnage growth for it in the six years ended 1953 well in excess of both New York and Baltimore. Increasing iron ore shipments from Venezuela and Labrador are likely to boost Philadelphia's import tonnage into first place in the nation in a few years.

INTEGRATED CONSTRUCTION — From Maryland comes a report of a $75 million building project to be located near Ft. Meade on 1,200 acres lying parallel to state routes 175 and 713. Plans include a $7.5 million shopping center containing 25 stores, 7,600 one-family houses with two, three, or four bedrooms, and 2,500 apartment units. The promoters have assured county authorities that land will be earmarked for schools, playgrounds, and parks and that all water and sewerage installations will be made by the builders.

CONSTRUCTION PREREQUISITE — The $130 million Baltimore Harbor vehicular tunnel had a successful financial kickoff last month. The bonds sold to finance the construction of the tunnel and approaches were in such demand upon initial offering to the retail market that sales had to be limited by allotments. The projected rising trend of heavy construction outlays by state and local governments is, of course, dependent upon the continued ability of these governmental units to borrow the necessary millions when needed and at suitable interest costs.

SENSIBLE SURVEYS — Furthering the intention of the Administration to minimize Government competition with private business, the military services have been ordered to review and make a cost analysis of 10 more commercial and industrial activities. Included are the production of lab, scientific, and engineering instruments; optical instruments and lenses; marking devices; ophthalmic items; watches and clocks; surgical, medical, and dental instruments and supplies; and photographic equipment. This order raises the total to 41 of commercial and industrial operations carried on by the armed forces that are being studied because they may "unnecessarily duplicate the work of private enterprises."

COST CUTTERS — Remington Rand reports that by mid-November it had received orders for 39 of its giant Univac electronic computing systems. Twenty-two were already installed and earning their average monthly rental cost of $25,000. The company has received a total of 237 orders for its junior Univac Systems, with 105 already in place. "Junior" rents for about $1,200 a month. Another member will be added to the family next year when a new intermediate Univac File-Computer, renting for $4,500 to $8,000 per month, becomes available. International Business Machines, another major producer of electronic "brains", has orders for over 1,400 electronic data-processing machines and calculators. Over 2,500 IBM electronic machines are being used by private firms and government agencies.

UNDER WAY — Bids have been requested for the first contract for construction work on the St. Lawrence Seaway. The shovels are scheduled to start digging next spring, and by the time Great Lakes ports have been "put next door" to the Atlantic, about four million cubic yards of dirt and rock will have been moved. And in the wake of contracts for work on the Seaway itself will come contracts for construction and remodeling of port facilities.

THROUGH THE TRANSIT — Passenger Belt Conveyors, Inc., of Akron, was awarded a $3.8 million contract to furnish and install the conveyor-belt shuttle that will replace the subway-train shuttle now operating between Times Square and Grand Central Station . . . Delegates at the recent CIO United Auto Workers conference approved recommendations that the guaranteed annual wage be given top priority in bargaining sessions . . . 1954's estimated record school construction of 55,000 classrooms loses some of its impressiveness against a Government estimate that 720,000 additional rooms will be needed by September 1959 . . . According to an F. W. Dodge official, current building levels are well below the point of being a speculative boom. After adjusting new construction volume in 1927 for changes in costs and population growth, it was twice as high on a per capita basis as in 1954 . . . State and municipal governments are now borrowing more than private corporations, and the prospects are for the gap to widen. It's likely that the $6 billion mark in municipal bond issues will be exceeded in 1954 for the first time in history . . . Five years ago there were only 240 miles of toll roads in use. Today there is five times that much in operation and about four times as much under construction. Building of another 4,700 miles of toll roads has been approved . . . For your copy of "The Big Industrial Fire — Your Problem", write to the Public Relations Dept., National Board of Fire Underwriters, 85 John St., New York City; or in the Middle-West to 222 West Adams St., Chicago; or to 465 California St., San Francisco. ▲▲

LEXIBLE
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POWERDUCT eliminates expensive rewiring when equipment must be moved.

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ATOMS IN ACTION

ON JANUARY 1, Lawrence Hafstad will join the staff of the Chase National Bank as atomic energy consultant. Since January, 1949 he had been director of the AEC's Reactor Development Division. His departure from government service was accompanied by regrets expressed from the highest echelons of the AEC, though it is acknowledged that he had been foregoing opportunities in industry for some time.

A PARTICULARLY sensitive appraisal of the atomic energy business was uttered last month by Thomas E. Murray, AEC Commissioner: ". . . I consider it no exaggeration, but the sober truth, to say that atomic energy has resulted in the greatest change in man's relations with nature since the fateful day in the Garden of Eden . . . Man has within his grasp an unlimited force, the very source of all energy in nature, atomic energy. While it cannot be said to be infinite, as is the power of Almighty God, nevertheless as a force it approaches absoluteness . . . Practically speaking, what this means is that every man is responsible to all men, and for all men. The measure of responsibility varies with individuals; the fact of it weighs upon every individual."

THE CRYSTAL BALL shows to some observers that there is no reason why the United States acting through its industrial firms cannot build and sell as many as 100 research reactors within two years. Similarly, scores of package-type power reactors could be designed, built, and sold to fuel-starved areas of the earth in the same two years. And as soon as nuclear power plants can be designed that generate power at the same price as conventional plants, utilities are seen to have no choice but to choose the atomic route to system expansion. A reactor plant's efficiency is not fixed at the time of completion, pointing the way to even lower costs of power as the reactor plant continues to operate.

THE DIXON-YATES deal is closed, and the AEC points out that several modifications favorable to the government were written into the contract before it was finally signed. Among these are provisions to limit the annual earnings of the company to $600,000 with no guarantee of profit. The AEC can take power from the plant for the entire estimated life of the plant — 45 years. The government can "recapture" the plant within three years of the contract's effective date if such action appears to be in the public interest. Provision is made for prior approval by the AEC of any firm engaged on the project as architect-engineer, contractor, or manager.

NEW APPOINTMENTS to accommodate the new activities assigned the AEC under the Atomic Energy Act of 1954 have been announced. The new lineup includes Harold L. Price as special assistant to the general manager for licensing. Price continues as deputy general counsel. Elbert B. Johnson is now acting director, division of inspection. Richard W. Cook continues as assistant general manager for manufacturing though he will take on duties as deputy general manager -- a position vacant since early this year. Harry S. Traynor becomes assistant general manager. Donald F. Musser is now director of the source and nuclear accountability division. Roy B. Snapp is special assistant to the Commission chairman. Woodford B. McCool is secretary to the Commission. And Paul F. Foster becomes special assistant to the general manager for liaison. ▲▲

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the Legal Aspect

MELVIN NORD

Consultant in Legal and Technical Problems

Registered Professional Engineer

Patent Attorney

. . . patent infringements

WHAT CAN YOU DO with a patent if you succeed in getting one? A patent gives the inventor the *exclusive* right to manufacture, use, and sell the item patented. He can assign (or sell) this entire bundle of rights to someone else, or he can license part of the rights to someone. For example, he can license the right to sell the item in a certain area.

If someone manufactures, uses, or sells a patented item without the patent holder's permission, he commits a patent "infringement." The offender can be assessed damages (i.e., his profits), and he can be enjoined from continuing the infringement. In order to halt infringement, the patent holder must show that he has a valid patent, and that it has been infringed. The outcome of such a suit can be any one of the following: patent ruled valid and infringed (relief granted), patent ruled valid but not infringed (relief denied), or patent ruled invalid (no relief and no patent).

In *Minnesota Mining & Mfg. Co. v. Neisner Bros., Inc.*, 122 Fed. Supp. 752, decided on July 26, 1954, a patent relating to "Scotch tape" was held valid and infringed. The patent in question represents a combination of two known elements which, taken together, are novel and inventive. The two elements are a non-fibrous, transparent, flexible film backing, and a water-insoluble, tacky, transparent, pressure-sensitive adhesive. Prior to this patent, it was thought that tacky adhesives must be coated on fibrous materials, such as cloth or paper. This patent showed that such adhesives could be coated on non-fibrous materials such as cellophane, thus creating a new product—Scotch tape.

The defendants were manufacturing a tape consisting of a cellophane backing and an adhesive coating that was water-insoluble, tacky, transparent, and pressure-sensitive. However, the adhesive did not contain the same ingredients as the coatings which the plaintiff, Minnesota Mining, uses in its Scotch tape. The plaintiff uses rubber-resin mixtures. The defendants used 100 percent resin. Nevertheless, it was held that this constituted an infringement, since there were claims in the patent that did not specify any particular composition of adhesive other than the broad designation "water-insoluble, tacky, transparent, pressure-sensitive." As the court put it, "By no *stretch* of the imagination can the defendant's adhesive be described in any other manner than as a water-insoluble, tacky, transparent, pressure-sensitive adhesive coating."

The defendants also manufactured a tape that used a certain rubber-resin adhesive that had been patented earlier by a different inventor. They claimed that they were following the instructions of this older patent, rather than those of the plaintiff's patent. The court held that the old patent on the adhesive didn't anticipate the present patent since the older patent was directed only to an adhesive, while Minnesota Mining's was directed to a *combination* of an adhesive and a backing. The court held Minnesota Mining's patent to be valid and infringed. The defendants had also violated a temporary injunction issued at the trial's start to stop making their tapes, so they were also held guilty of contempt of court.

In *Glitsch v Wyatt Metal Boiler Works*, 121 Fed. Supp. 746, decided on June 1, 1954, a patent was held to be valid but not infringed. The plaintiff's patent involved a design of bubble caps and plates for use in distillation towers such that corrosion was minimized and cleaning made easier. The defendant manufactured and sold bubble caps of a similar design. But the court held that although the plaintiff's patent was valid, the defendant's caps did not infringe.

No reason whatever was given for the decision. The judge merely said, "I think by a study of the prior art, we might roughly arrive at the right of another, than the plaintiff here, to enter this field in competition with the plaintiff, but, a careful study of that prior art does not reveal what the plaintiff

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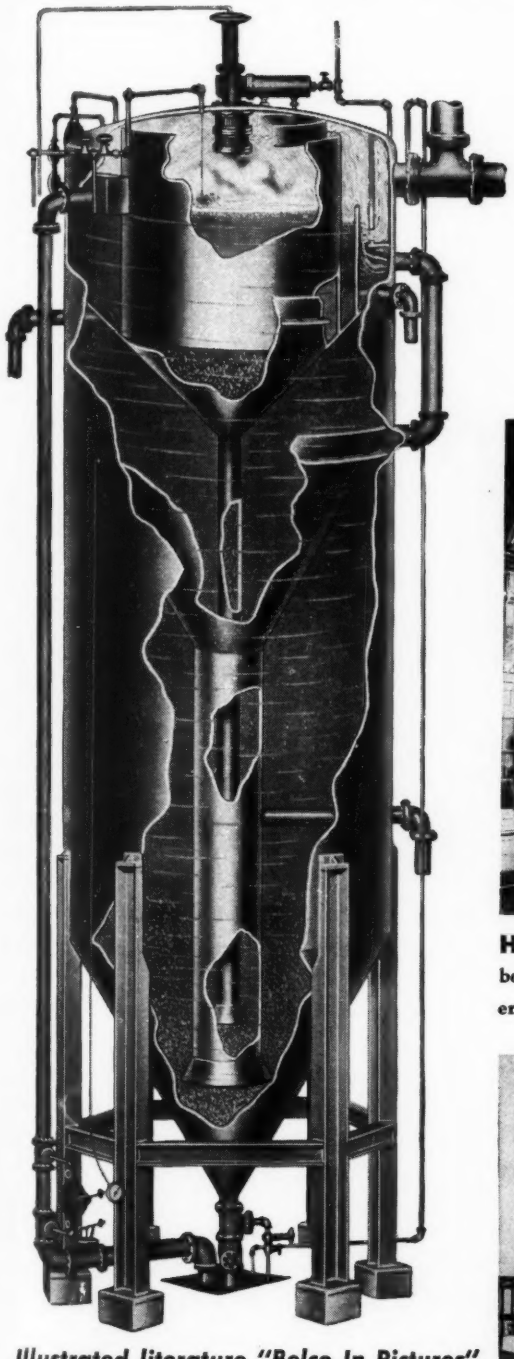

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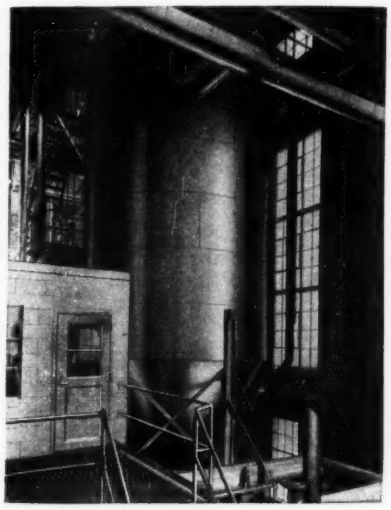
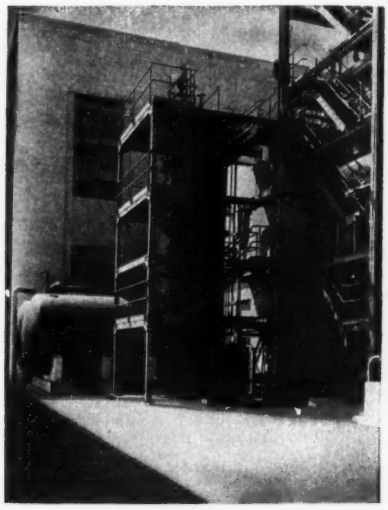
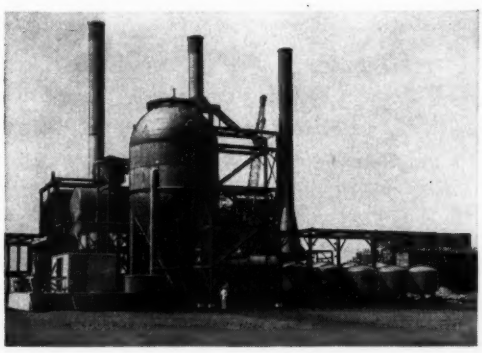


HOT LIME SODA — Installation in boiler house at large eastern oil refinery. Has capacity of 200,000 lbs/hr.



HOT LIME SODA — Installation in large southwestern utility. One of three units with 90,000 lbs/hr total capacity.



HOT LIME BELCOLITE — Installation at large southern chemical company. Capacity 600,000 lbs/hr. This plant embodies "thoroughfare" operation of separate deaerator and hot process tank. The large hot process tank was designed, built and erected by Belco under its contract with customer.

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here did reveal, and, succeed in doing. I also think, however, that such prior art, and, such apparent defects as the defendant said were manifest in the plaintiff's patent justified its entry into this field of making, and selling, bubble caps, such as it made. I believe, therefore, that the fair thing to do here, the just thing to do here, is to leave the parties as they were, before they entered court, except, that the cost of this case should be adjudged against the defendant, no damages, no injunction."

This is a mysterious decision. It illustrates some things about patents, namely, that judges deciding patent cases do not necessarily understand the technical aspects of patents, and that even if there is a valid patent, it may be so narrow that it can be easily circumvented by a competitor.

In *Berkeley Pump Co. v Jacuzzi Bros., Inc.*, 214 Fed. (2d) 785, decided on June 30, 1954, a patent pertaining to a motor-driven water pump for use in "deep wells" was held invalid, in view of prior art. The plaintiff and defendant were competitors in the manufacture and sale of motor-driven water pumps for use in deep wells on small farms. The plaintiff sued for infringement and asked for damages.

In prior deep-well pumps, a jet was used to raise the water to the top of the casing; it was next pumped to a higher pressure by a turbine impeller. Part of the high-pressure water was returned to the jet. As a result, the pumps could not discharge both high- and low-pressure water simultaneously, but only one or the other.

The new patent provided for a number of turbine impellers in the casing, instead of a single impeller. This permitted the simultaneous discharge of both high- and low-pressure water—low-pressure water for irrigation, and high-pressure water for household use. The trial judge held that there was nothing inventive about this aggregation of known elements, and that the patent therefore was void. On appeal, the appellate court found that the trial judge had acted within the scope of his authority in directing a verdict for the defendant.

This case illustrates a rule. In a patent whose novelty relies solely on a new combination, the old elements making up the invention must perform an *additional* and *different* function by virtue of the combination itself as compared to the functions they perform when not in the new combination. In this case, the elements performed an *additional* function, namely, pumping *both* high- and low-pressure water simultaneously. But this is not a *different* function, because it was already known how to pump either high- or low-pressure water. ▲▲

A Matter of Ethics

Winner of last month's problem:

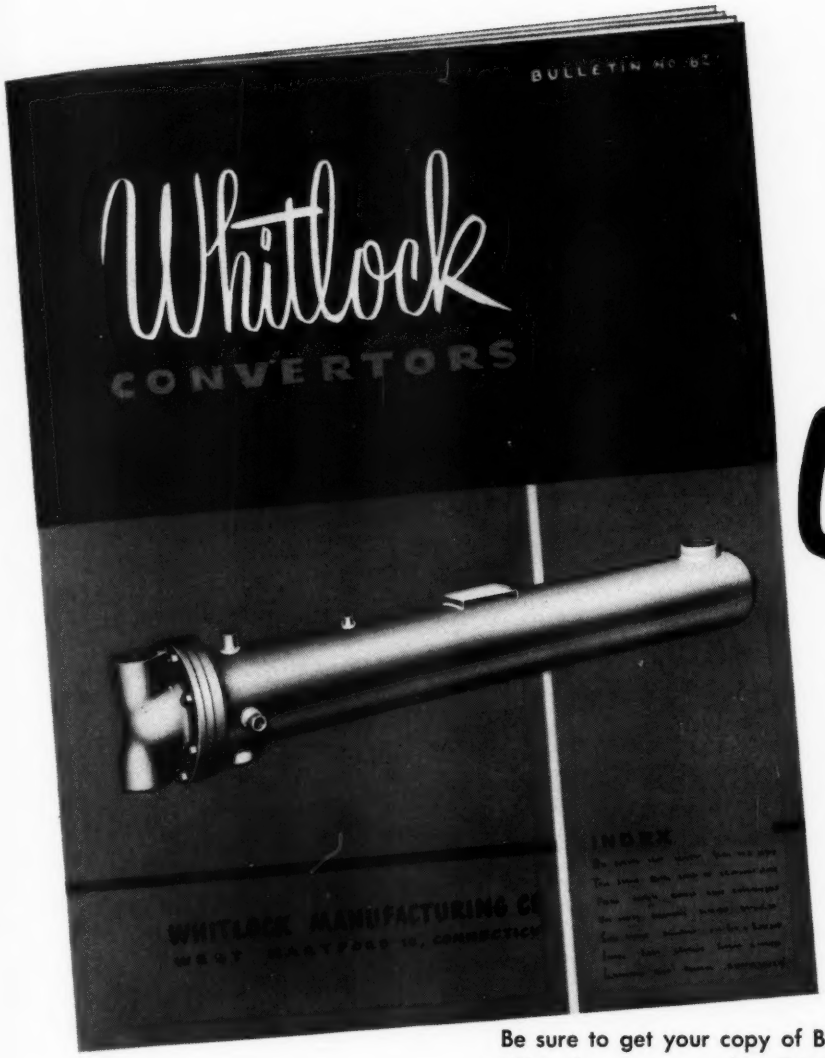
There appears nothing to be done by Smith & Jones but take it on the chin and redesign the structure. They were negligent in not having studied the site before they started plans and having a conference with the client to discuss the design—either use the old piling or scrap it and use new—with the design percentage fee adjusted according to the decision.

Certainly no reputable engineer would say the old piling was not suitable for use when he knew it was suitable—that is unthinkable.

S & J violated the "Canon of Ethics" by not acting "as a faithful agent or trustee" in investigating the effect of the fire on the old piling. Normally the Engineer should include, in his contract with the client, that the client should pay for under-surface investigations if it is mutually agreed such investigation is needed.

This case does not seem to be of ethics—it is one of poor business judgment and procedure on the part of S & J. Their monetary "loss" may be an investment that will yield dividends in the future, if they act as gentlemen. I trust they did.

E. L. Filby, Black & Veatch



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ALTERNATE MATERIAL SUBMITTED BY THE CONTRACTOR IS GIVEN FULL CONSIDERATION. APPROVAL, GIVEN BEFORE THE CONTRACT IS SIGNED, IS BASED ON COMPLIANCE WITH THE SPECIFICATIONS.

Be Smart — Approve Alternates Before the Contract Is Signed

CE exclusive

LYMAN C. GROSS, Consulting Engineer

Specializing in mechanical plans for schools, hospitals, and industrial and commercial buildings, Lyman Gross entered private practice in 1947. He began his engineering career in 1921 as a mechanical engineer for W. K. Robertson of Minneapolis. In 1925 he joined Magney, Tusler, & Setter, serving as chief mechanical engineer until 1933 and again from 1944 to 1947. He also has had experience as an application engineer for Crane Co. and Minneapolis-Honeywell. He is a member of the Minnesota Board of Registration, and is president of the Minneapolis Chapter of the Minnesota Society of Professional Engineers and past state president of ASHVE.

SELECTING equipment and materials requires considerable time during the design stage of any engineering project. In many instances, several manufacturers will have equipment providing similar ratings but of different sizes, shapes, and arrangements. The size and shape may be important, since the space allowed for mechanical equipment frequently is determined by architectural design and economy. If working with an existing building, it may be limited by available floor space or by the arrangement of existing equipment.

Also important in the selection of equipment and

materials are the manufacturers' reputation and qualifications. The manufacturer should be financially sound and willing to back up the ratings and operation of its equipment.

The manufacturer also should have local representation. The contractors depend on these representatives to give them accurate quotations based on the specifications. The representative should be reliable and should have the ability to provide adequate service to the contractors prior to the bid, since the quotations must be received in time for the contractors to make up their bids.

The first price quoted should be the best price available. A manufacturer's representative who does not give his best price at the time of the bids may cause a contractor to lose the contract. He may cause the project to be cancelled because the bids are too high. Also, the owner does not benefit from price cutting after the bids have been received.

A good manufacturer's representative will follow up the proposal after the bids have been opened by contacting the contractors and providing necessary information on the equipment for the consulting engineer's consideration. He should be able to give the contractor proper installation instructions, and he should be interested enough to make sure the equipment operates satisfactorily after installation.

Naming Several Manufacturers

Some consulting engineers name the equipment of several manufacturers for each item in the specifications. This may be practical if the equipment is of a practically standardized design. However, many types of equipment of equivalent ratings and capacities have different measurements. Thus, the consultant must spend considerable time in preparing his plans to accommodate the various sizes and shapes of the several named types of equipment. He may find that the item selected by the contractor does not fit into the job. It then may be necessary to reorganize the work in the field. Even when several names are used, the consultant may find that the contractors desire to submit other makes for consideration.

From past experience, we have found that the use of one name only has been the most satisfactory when the specifications include a clause permitting the contractor to submit other material for consideration. It is important to give consideration to alternate material since this creates fair competition and allows the client to obtain the best price on equipment or material of the same quality.

Time Factor

The most important item in the consideration of alternate material is the time for submitting it for approval. This has been debated many times and many methods have been used. Some consultants have requested that alternate material be submitted before the bids are taken, only to be swamped with a multitude of manufacturers' representatives submitting material for approval. This method takes considerable time because the consultant must investigate each item submitted. And the contractor may not even suggest the items considered.

Some consulting engineers give the contractor a certain number of days after the signing of the contract to submit alternate material for consideration. This method leaves much in doubt at the time the contract is signed and may lead to debates or arguments as to the merits of equipment during the time of construction.

In some instances the contractors actually order alternate material before approval and, if it is rejected, they inform the consulting engineer that the manufacturer of the material named would be unable to make shipment in time and that to use the specified equipment would necessitate a delay in the work. This only succeeds in embarrassing the engineer. It also permits the contractor to delay the purchase of material and creates a new period for him to receive bids from sub-contractors. Such a practice may become quite unethical. It offers opportunity for the contractor to put undue pressure on the sub-contractors to reduce their prices. Under such a practice, the sub-contractors will not submit their best prices at the time of the bid by the contractor, and the owner will not benefit by the price cuts after the signing of the contract. Also, the sub-contractors will be prone to reduce the quality of their work.

Before Contract Is Signed

We believe that it is only fair that the owner should know what he is getting when he signs the contract. When buying a car, the buyer usually settles all the details before signing the contract. It is not likely that a person buying a car would sign a contract and then tell the dealer that he has thirty days to determine what model he will furnish or to tell him what type or grade of accessories he will supply.

To establish the material to be included in the contract, we use the following in the specifications under the heading, Approval of Materials:

"In any case where a specific definite trade material is mentioned in these specifications, it is to be understood and construed as meaning to indicate only the type of material or equipment desired, and is not intended in any way to bar the use of any such material or makes of approved quality. *However, the approval of any material or equipment other than that specified shall be obtained in writing from the engineer before the contract is awarded; otherwise it shall be assumed that the contractor will furnish the material or equipment specified.*"

After the bids have been received, the low bidder is requested to submit a letter indicating that

the bid was based on the items as named in the specifications, or listing the alternate items he wishes to have considered for approval.

We then advise the owners that the signing of contracts should be held up until we have received and approved the list of alternate equipment. This arrangement gives us about a week or so to investigate the contractor and, at the same time, allows the contractor time to confirm quotations received from the sub-contractors or material representatives.

If the reasons contractors submit alternate material were analyzed, few of them could be stated as being for the benefit of the client. The more common reasons for submitting alternates would fall into the following general categories:

¶ Lower price on similar quality material
¶ Lower price on inferior or sub-standard material
¶ More convenient purchasing arrangement
¶ Personal friendship
¶ Better delivery
¶ Saving in the cost of installation
¶ Unsatisfactory experience with the representation of the items specified
¶ Relationship with jobber or representative.

Approving Alternates

Alternates for material are checked carefully, being considered both on the basis of fair competition and on the basis of the benefit to the client. Our approval is based on strict compliance with the specifications, thus protecting the client and eliminating the fears of contractors that they may be competing with other contractors whose bids are based on inferior or sub-standard quality material.

Should we find that the equipment or materials submitted do not meet the requirements of the specifications, we advise the contractor and he may then submit other alternate equipment. We often find that the items specified by name are readily accepted when the contractor is informed that the alternates submitted do not meet specifications.

When materials submitted as alternates do not meet the specifications, it is usually because the material salesman bids without checking the specifications or because he was trying to get by with something less than required in the specifications. This type of quotation usually causes the contractor to lose faith in the alternates, and he is then inclined to use the specified materials.

Letter of Acceptance

After we are satisfied that material submitted or finally agreed upon complies with the specifications, we write a letter acknowledging the approved material as far as names of manufacturers are concerned, subject, of course, to final approval of shop drawings or data for compliance with the requirements of the specifications. Copies of the letter are sent to the architects, owners, and any others that may be concerned with the contract.

The practice of approving alternate material before the contract is signed, and our procedure for approving this material, has proven very successful. We find that it eliminates the long delays and discussions often encountered with respect to alternates submitted by contractors. ▲▲

CE quotes --

"In considering the time scale for the development of economic nuclear power, one must be careful not to substitute hopes for facts with regard to the present state of development of nuclear power and must not ignore the capabilities of the competition — conventionally fueled steam power plants. . . .

"It is inherent in the definition that an economically competitive nuclear power plant not receive or benefit from any direct or indirect subsidies and that it not receive a price representing more than the actual value for any by-product materials produced. Eventually fissionable materials produced will probably be worth only the savings in new nuclear fuel obtained by re-using them in the plant producing them, or some other plant. . . .

"Economic evaluations of nuclear versus conventional power plants too often compare 'hopes' for nuclear plants in 5 to 15 years with some sort of an average performance of conventional power plants already built and in operation. . . . Bear in mind that the true test of having an economically competitive nuclear power plant is that it is equal to or better than the best conventional plant which could be built instead. It seems likely that the average conventional power plant built 10 or 15 years from now will be as good as the best being built today. . . .

"An important factor in the evaluation of conventional power plants is the cost of fuel. . . . Although the cheapest fuel, natural gas, will probably increase in cost before very long, it is not possible to demonstrate that our basic fuel, coal, will increase in cost to any large extent even over a rather long period of time. In any case, it is possible to partially compensate for increased fuel costs by building slightly more expensive, but considerably more efficient, power plants."

W. Kenneth Davis, Deputy Director
Division of Reactor Development
U. S. Atomic Energy Commission

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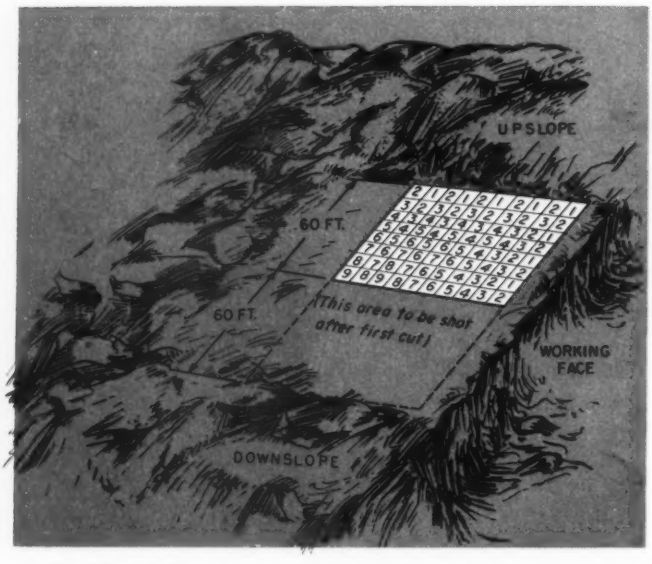
Direction and distance of throw of broken rock can be controlled more precisely. Difficult rock formations, with troublesome combinations of weak and dense rock, can be broken efficiently. Secondary blasting is reduced.

Projects involving explosives can be completed quicker. With better fragmentation and the improved control of distance and direction of throw of rock, removal of broken rock is done more easily, faster, and with smaller equipment. Because larger quantities of explosives can be detonated at the same time (although not simultaneously), interruptions are reduced. Less back-break and unnec-

William T. Mahood is well known in the construction industry. He joined Atlas Powder Company in 1936, and went to work in the explosives department. From 1938 to 1943, Mahood was with the contracting department. He was then made district manager in Seattle. In 1946, he became San Francisco district manager. Last January he was called back to Wilmington to head the contractors section. He took his college work at Bucknell and Temple.



THIS IS A TYPICAL DELAY PATTERN. EARLY SHOTS MAKE WAY FOR ROCK THROWN BY LATER BLASTS.

essary damage to the face means less additional preparation for finishing and less crow-bar or jack-hammer work to remove partially loosened chunks and fragments.

Improvements

The developments responsible for the improvements in blasting include:

¶ New evidence on the relative efficiency of different points of blast initiation.

¶ Millisecond delay blasting caps.

¶ Alternate velocity loading.

¶ Improved blasting machines.

¶ Large-diameter explosive charges with an inner gelatin core.

¶ Photographic methods for evaluating explosives, evaluating patterns, detecting misfires, and detecting poor technique or careless execution.

Until recently, no special attention was given to the point at which the charge in a hole should be fired. As a rule, explosions were initiated at the top of the hole in bore holes of large diameter. It was thought that the point of detonation did not matter since the explosion was almost instantaneous. Recent experiments and widespread practice show that better results are obtained when explosives are detonated at bottom for large-diameter holes and small-diameter holes.

Bottom Detonation

With proper stemming, bottom detonation gives better confinement of the explosive gases and makes them expend more of their energy in breaking rock instead of "geysering," which throws the rock excessively. Action on the "toe" is more pronounced with bottom detonation. When there is a face parting of the rock at the floor level, the point of initiation is placed half way up the hole, or at some other point where there will be maximum confinement.

One of the most important developments in explosives science is the use of millisecond delay electric blasting caps, introduced in 1945. In the past, all holes in one series were detonated at the same instant—either by instantaneous electric blasting caps or detonating fuse. The shockwave, vibration, and noise were often intense. Fragmentation was usually irregular. Back-break was sometimes severe, and control of throw was virtually impossible.

Delay Patterns

With millisecond delay electric blasting caps, a wide variety of ingeniously planned delay patterns can be set up to stagger the explosions in the various holes. The delay element is built right into each cap. The electrical impulse to each cap is initiated at the same time, and the caps fire themselves from zero milliseconds to 550 milliseconds after the first explosion goes off.

A wide variety of patterns can be used with millisecond delay caps. As a general rule, the long-delay caps are used in the back row of holes and along the sides, where, for example, a cut is being made through a hill. The short-delay caps are used near the working face. By providing a path of least resistance, the shorter delay caps allow a place for the rock broken by the later caps to go.

Increasing attention is being given to the better breakage possible with millisecond delay electric blasting caps. In some cases, secondary blasting has been virtually eliminated. Because the size of the blasted rocks is reduced, smaller shovels and other equipment can safely be used to handle the muck. Being of relatively finer size, the muck can more readily be used as fill. (On the West Virginia Turnpike, where noise and vibration were not problems, millisecond delays were used purely for control and breakage.) Because the direction of throw can be controlled within rather close limits, muck can be deposited either close to the slope or away from it. It can be windrowed in the center of the cut.

Shale and Harder Rock

More than one delay cap may be placed in the same hole under certain conditions, when either a single hole or many are being shot. For instance, the working face of a quarry or open-pit mine may be composed of very hard, massive rocks above a section of soft, weak shale. If the entire charge in the hole is detonated at the same time, the force of the explosion will blow out the shale because the force will follow the path of least resistance. The breakage of the massive rock will be poor. Delay caps permit detonation in two or more blasts separately by several milliseconds.

The charge for the shale is loaded and stemmed

to separate it from the charge for the massive rock. One millisecond delay cap sets off the top charge, breaking the massive rock with no escape of force through the shale because of the stemming. A few milliseconds later, the charge for the shale is blasted by the other, longer delay cap. Explosives of different velocity may also be used in a case like this, with a low-velocity explosive loaded in the shale and a high-velocity material in the hard rock.

Alternate Velocity

The most recent innovation in explosive practice is alternate velocity loading. Using bottom detonation and the millisecond delay blasting cap, it has been found that loading a row of holes alternately with high-velocity explosive and medium-velocity explosive results in far better fragmentation — especially in hard, brittle rock. While the rock is under stress from the low-velocity explosives, which explode first, it receives a sharp impact from the high-velocity material.

The general public has unfortunately developed a poor opinion of blasting. This is not warranted today. The force of explosions and the direction of throw can be influenced away from such vulnerable areas as houses, railroads, public highways, or power lines.

A reduced quantity of explosives detonated by millisecond delay caps will break the same amount of rock as a larger quantity of explosive set off simultaneously. Because the vibration is less, more powder can safely be shot at one time than with instantaneous methods, provided a proper point of initiation is established to reduce air concussion. Nuisance and hazard to uninformed citizens near the blasting area are thereby reduced, and relations with the public improved.

New York Thruway

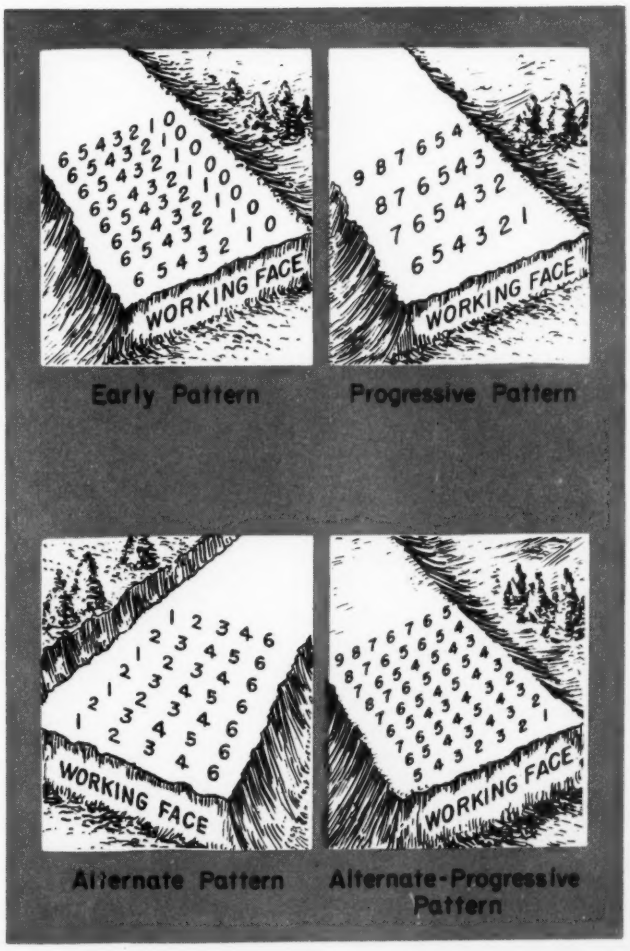
On the Suffern section of the New York State Thruway, the L. G. DeFelice Company, North Haven, Conn., sets off as much as 1500 pounds of explosive at once, just 25 feet away from dwellings! Not only is flying rock fully controlled by the use of millisecond delay caps, but the average citizen is not even aware that a blast has been detonated. When the job was first started, the people of Suffern were apprehensive about the blasting operations because of previous bad experience.

On the same section of the New York State Thruway, an interesting sequence of cut making is employed. Instead of making the full 120-foot width of the cut at one time, DeFelice makes the cut in two sections. DeFelice blasts and excavates the 60-foot section farthest from the houses first. Then he blasts the section closest to the houses, using millisecond delay caps to direct the throw of rock into the first cut.

Unusual jobs are accomplished by modern explosives and techniques. Where shovel work on the bench is tedious and expensive, the throw of the blast can be directed so that the broken rock is thrown down slope where it can be handled by bulldozers.

In cases where aggregate can be produced on or near the job, its cost can be reduced by the better fragmentation achieved with millisecond delay blasting. In tunnel work, where breakage is especially important because using large equipment is impractical, modern explosives play right into the hands of the engineer.

To the consulting engineer, these improved blasting techniques mean new freedom of design. By anticipating the use of such methods on his clients' jobs, the consultant no longer need worry, as he might have in the past, about public nuisance or danger. With brute force blasting giving way to sophisticated control, the use of explosives is not limited to the wide open spaces any more. Consultants might well ask if their clients are benefiting from the latest in blasting. They might well ask if they themselves really know what's new in blasting. ▲▲



DIRECTION OF THROW AND EXTENT OF BREAKAGE CAN BE PREDETERMINED BY PATTERN SELECTION.

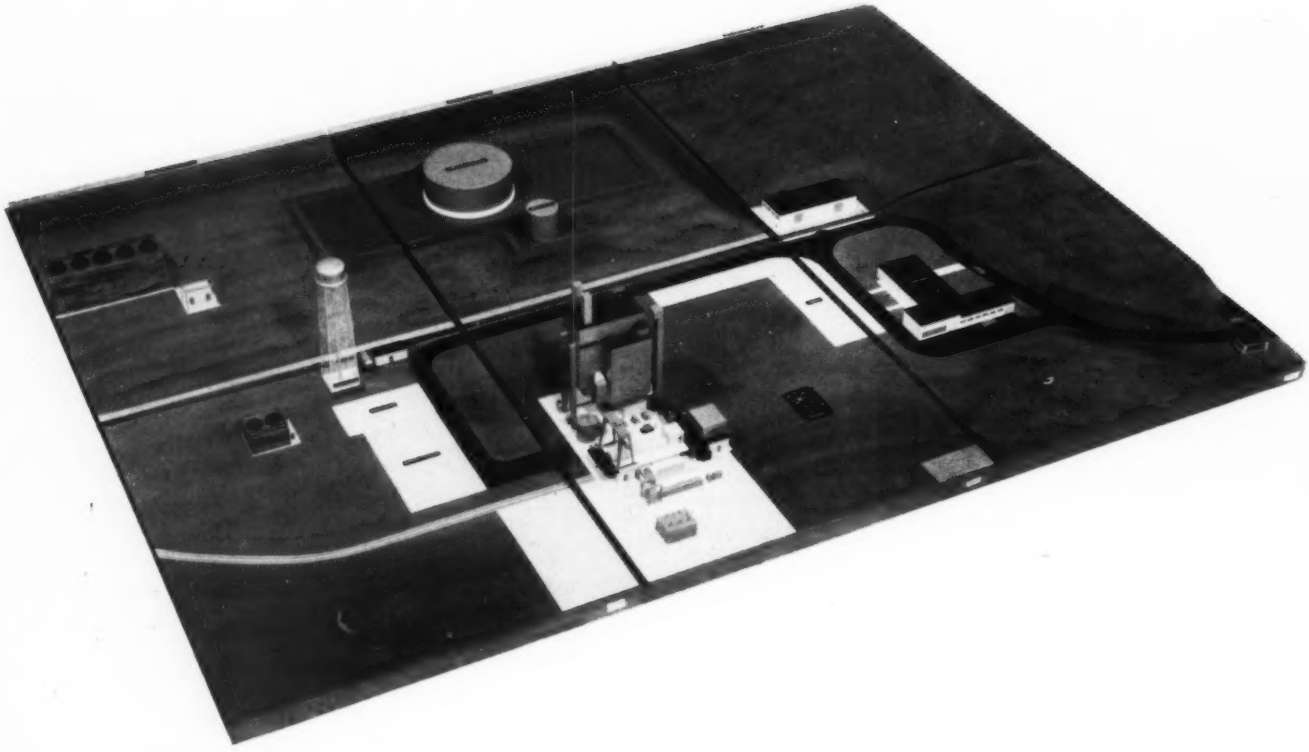


FIG. 1 — MODEL OF POWER PLANT SITE IS USEFUL IN ESTABLISHING GENERAL ARRANGEMENT OF MAJOR UNITS.

New Tool for Power Plant Design

Three-D Scale Models

ROGER J. SHERMAN
Project Engineer
Ebasco Services, Inc.

CE exclusive

SOME EIGHT years ago our firm started to use scale models as a tool for designing power plants. The approach was most cautious because our experiences with models prior to this time was limited to some very expensive, elaborate, display types prepared from completely checked drawings. The accent had not been on geometric scale.

The reasons for considering this fairly radical design tool stemmed from several factors:

¶ A continuous study and effort to improve and advance design practice.

¶ An unprecedented work load that was on us and on all industry.

¶ The relatively small number of highly experienced engineers, designers, and checkers available.

¶ The increasing complexity of power plants.

¶ The increasing total costs of design.

One thing that had to be kept in mind is that a model is nothing more or less than another design tool—such as a diagram, perspective drawing, or orthographic projection. As such, any one type of model has limited usefulness. This is the first and perhaps most significant thing we learned about models. Next most important is a knowledge of just what the limitations of the various types are. Often, more than one model can be used on one project.

When the idea of using a model is first introduced, you will often find substantial mental resistance. It is not unusual to find designers, and even the more inflexible of engineers, carefully examining a

model—not seeking improvement in design—just trying to see where the model maker failed to interpret the drawings correctly. This initial lack of acceptance is not nearly as surprising as the speed with which it later disappears. Designers who had been among the most reluctant to use our early models were the first to complain about the hardship of being without them when we planned to send them out to the field during later stages of the project.

When we first used a model, we had thought that with sufficient experience we could actually lay out piping on the model, and then prepare drawings or sketches for shop fabrication and field erection. Claims have been made recently of substantial dollar savings as a result of this procedure. However, the projects on which six-figure design savings are claimed are either large refineries or process plants —not power plants. There are three important differences between process plants and steam-electric stations:

¶ The total cost of piping is far greater in a process plant than in a power plant.

¶ The relationship of piping cost to total project cost is much greater in a process plant.

¶ The runs of piping follow in channels to a greater extent.

We do not now attempt to lay out piping on a model before detailing its design. However, we frequently do use the model to visually plan general runs; then we proceed to detail.

It soon became apparent that familiarity on the part of the model maker with the character of plant could contribute greatly to speeding model preparation, decreasing cost, and improving usefulness of the model. This prompted us to investigate the advantages of making our own models, as some large shipbuilding and naval architectural organizations have long done. However, the model-making work load tends to be quite sporadic. The investment in equipment is not high, and the type of space that can be used for the work is not too expen ive. But the specialized personnel required looked like they would be a problem.

A model-making group would have to consist of about three men. They probably could not be effectively assigned to other technical work when not engaged in model making—model making having many of the aspects of a labor of love. Therefore, to economically make its own models, an engineering firm would have to go into the open market and offer its services as model makers in order to keep a level work load in their shop. Most engineering firms would prefer not to do this. Hence, the need for the independent and specialized model maker.

So much for background. Now consider models

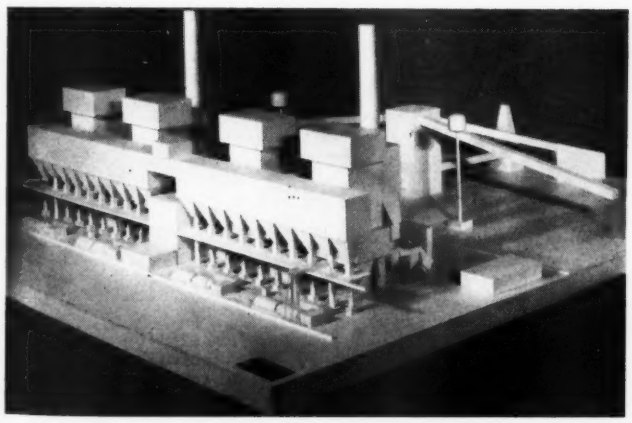


FIG. 2 (TOP, LEFT) — CLOSEUP VIEW OF FIRST MODEL OF THREE BUILT FOR A SINGLE PROJECT.

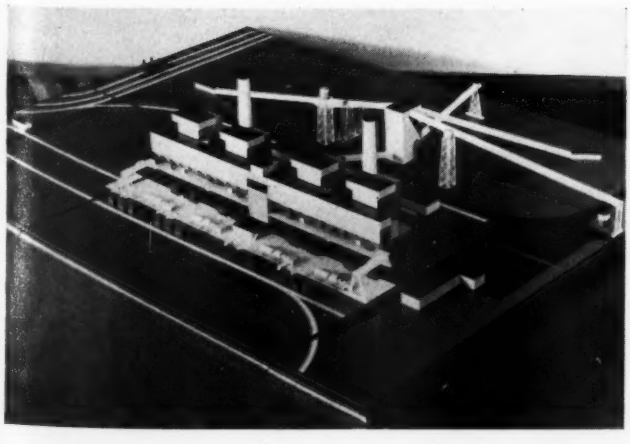
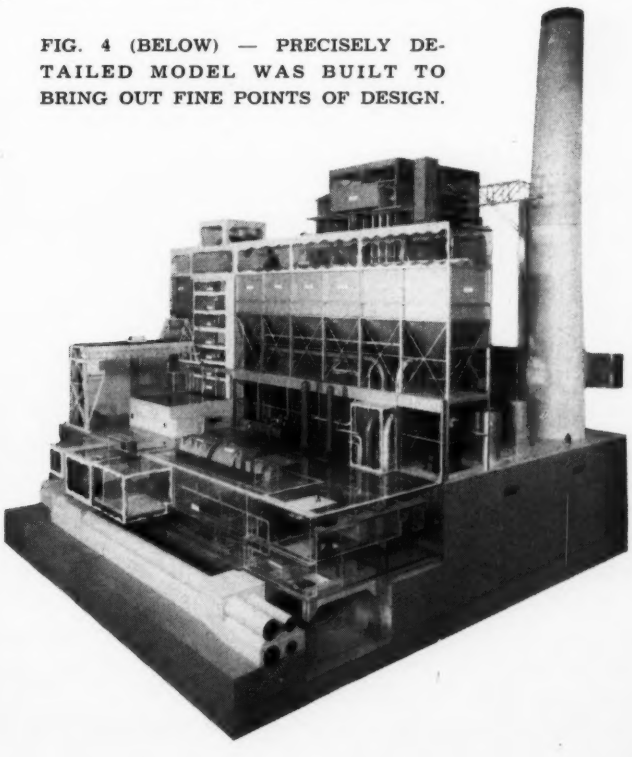


FIG. 3 (BOTTOM, LEFT) — MORE DETAILED MODEL OF FULL SITE FOLLOWED AS DESIGN PROGRESSED.

FIG. 4 (BELOW) — PRECISELY DETAILED MODEL WAS BUILT TO BRING OUT FINE POINTS OF DESIGN.



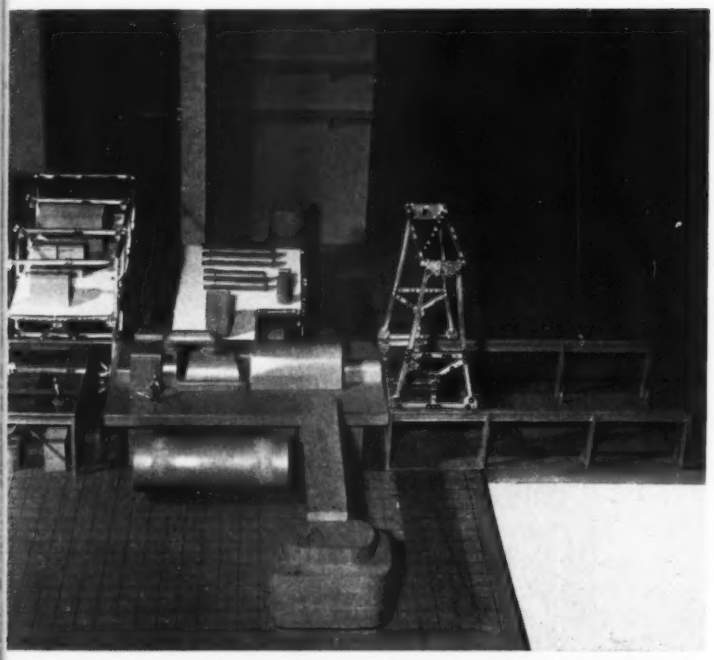


FIG. 5 — MODEL OF BITS AND SCRAPS SOLD THREE CLIENTS ON JOINT ENGINEERING OF SIMILAR JOBS.

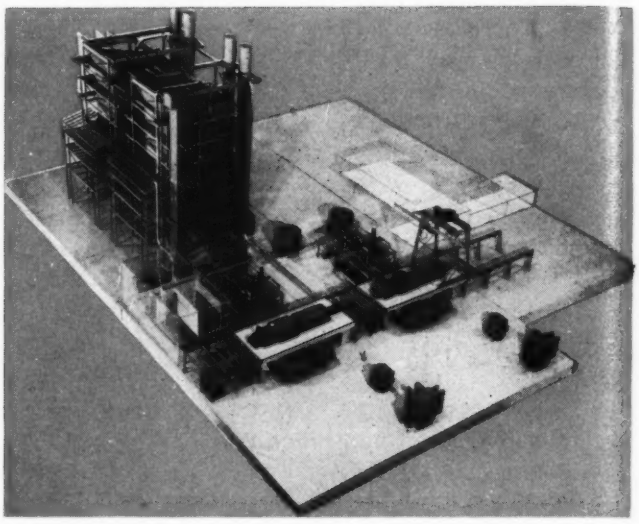


FIG. 6 — ADVANCED MODEL OF SAME PROJECT AS IN FIG. 5 KEPT CLIENTS' DECISONS CONFIRMED.

as they contribute to the detailed design of a project.

Since a model is only another design tool, deciding whether or not to use one should be the same as deciding whether or not to make a certain drawing. A given drawing or a given model should be made only if it is the least expensive way of making necessary decisions or only if it is the most effective way of making information available. Not every project can economically justify the use of a model.

Site Model

One type of model aids in visualizing the development of the complete plant on its site. This type of model (Fig. 1) is constructed of pieces that can be easily transported. The scale is small, usually 1/32-in.-to-the-foot or 3/16-in.-to-the-foot. These models usually show major features such as steam generating units (or the boiler room of enclosed plants), stacks, turbine pedestals, turbine and gantry cranes (or turbine rooms of enclosed plants), transformers, oil tanks, intake structures, cooling towers, railroad tracks, roads, walks, and coal handling conveyors.

In addition to aiding the experienced engineer studying a site development, this type of model is invaluable in clearly portraying the project to management. Management may not have the time to carefully study a set of drawings, or may not have the background to correctly interpret or visualize drawings. We use such models for this purpose on many occasions, and find that they contribute to decisions on such subsidiary items as selection of color schemes, placement of illuminated signs, planning of landscaping, awakening of public interest in the project, and elimination of neighborhood antipathy toward projects.

The next step beyond the model shown in Fig. 1 is that shown in Fig. 2. This is a development model of the immediate generating plant area. It extends to the coal-handling area immediately adjacent to the plant but does not cover the rail and river coal unloading areas, water treating building, switchyard, or river intake. This model was prepared in the very early days of design, during the first month of engineering. The model itself is comparatively crude and blocklike. It is painted in dull white to take pencil marking. The scale is 1/16-in.-to-the-foot.

Three Models Used

The magnitude of this particular project and the requirement for speed of design was such that, shortly after the model of Fig. 2 was built, we built the model shown in Fig. 3. This model, in somewhat greater detail, represented the complete site design acceptable to the client's engineers. This model was to be reviewed and discussed by more people, including top management of the client company. It was built to a scale of 1/32-in.-to-the-foot. The combination of models so clearly illustrated the design that only minor changes took place as the detail design progressed.

All of these models helped locate the plant on a site and develop the plant's general arrangement. All were of small scale, the largest being 1/16-in.-to-the-foot. Models of larger scale can be advantageously used for some projects to aid in the detailed design. Fig. 4 shows such a model for the same project as Figs. 2 and 3.

The model in Fig. 4 is to a scale of 3/8-in.-to-the-foot. Transparent walls show the piping. (The large-scale model represents only one unit; this was all that was necessary since all four of the units were the same.) The type of model shown in Fig. 4 is of great aid in checking interferences, adequacy and

perfection of equipment arrangement, plus accessibility of equipment and major valves for operation and maintenance. The model can also be used to visualize runs of smaller piping not shown on it, thereby reducing the cost of drawings for the smaller piping and eliminating many interferences while reducing checking time for drawings.

When the model in Fig. 4 was first proposed, we intended to lay out the piping on it and then record the layout on design drawings for fabrication and erection purposes. That objective was abandoned in the face of delays by the model maker and ourselves, because of our inexperience with such an approach to design, and basically because (as stated previously) such a method proved not to be the best approach.

Certain areas of some plants are quite compact. To avoid interferences as well as to provide adequate operating and maintenance clearances, a model of the area in relatively large scale may be warranted. The discovery of a single interference, and the elimination of what would have been a field change, can sometimes save more than the cost of the model. We have often used models in scales of ½-in., ¾-in., and even 1-in.-to-the-foot in developing and checking designs to take the best advantage of very limited spaces.

Take Color Stereos

On models of ½-in.-to-the-foot, we prefer colored, solid tubing to gain one further advantage from the model. For the compact areas represented, poor sequencing of piping erection can contribute to higher erection cost. Since erection planning is done largely by our field organization while the design is progressing in the office, both groups cannot benefit from the model's presence. We therefore take three-dimensional color pictures of the model in the office, and send them to the field. The combination of different colors and stereoscopic views very clearly shows the details necessary for construction planning. This is our most recent application of models, and indicates the constantly expanding usages that can be made as experience with models increases.

One of the best examples of the many uses of models in design is shown by Fig. 5. We had the opportunity to design three new plants, each consisting of four units, for three different companies at just about the same time. Unit size, fuel pressure, and temperature were all the same; the savings in engineering and equipment cost through duplication were apparent.

Model Tells All

The most difficult thing would be arriving at a design acceptable to many different people that would best suit the requirements of different makes of major equipment. It would have been expensive and time consuming to make study drawings of the many arrangements that undoubtedly would have to be made to satisfy all interested parties. Also, different people examining drawings for a very limited time often interpret them differently.

We decided to make very crude scale pieces of power-plant equipment out of wood, Masonite, Erector sets, and odd parts. These were taken to a meet-

—Continued on page 73

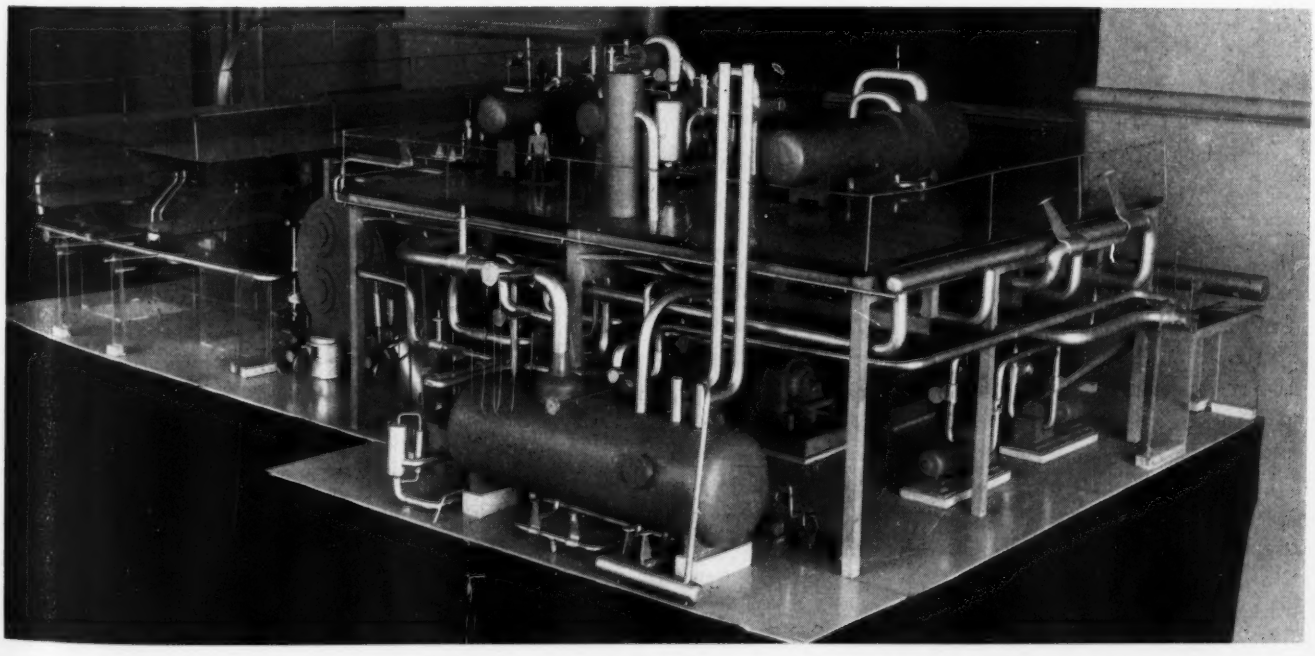


FIG. 7 — WORKMANSHIP CLEARLY SHOWN HERE IS TYPICAL OF MODELS SUCH AS THOSE IN FIGS. 4 AND 6.

RESENTMENT MAY DEVELOP IF KEY PERSONNEL FEEL "LEFT OUT."

CE exclusive

Mutual Understanding

The Key To Better Client Relations

BY STANLEY J. DORST

An economic analyst on the Executive Office Staff of Standard Oil Company of California, Mr. Dorst has also served as a consultant on Arthur D. Little's Operation Research Staff and on the Administrative Staff of California Research and Development Co., a prime contractor of the Atomic Energy Commission.

COMPETENT CONSULTANTS, who approach assignments in a spirit of service rather than sales, with the hope of contributing tangible benefits, are welcomed by clients and commended by society. The conscientious embracing of such an approach, however, requires more of the consultant than simply making recommendations. Many consultants, for example, overlook service to the client in attempting to maintain an objective and problem-centered approach. In offering their advice from arm's length they may feel very professional and superior, but the benefits to the client may be lost in a tangle of misinterpretation and prejudice.

The degree of service that will be derived by clients from consulting relationships is ultimately dependent upon the extent to which the client's organization is able to utilize the consultant's suggestions. Thus, the client's representatives, who will

be responsible for the application of new procedures, will need to draw upon the knowledge of the consultant and to integrate the consultant's ideas with his own personal outlook. If all the executives involved could be counted upon to perform these functions satisfactorily, on their own initiative, many complications of consulting would not arise. Consultants could simply study the problem, detached from its organizational context.

Among those executives who will be essential to the application of solutions, however, frequently there will be some who are prejudiced, indifferent, or quite incapable of seeing the point. Then the consultant is confronted with the alternatives of ignoring the executives' feelings or of attempting to effect harmonious relationships. Since ultimate benefits to the client hinge on acceptance of his suggestions, the consultant should assume the responsibility of understanding both the technical aspects of the problem (an objective view) and the manner in which the concerned executives view the problem (subjective view).

Basic Conditions

In general, three basic conditions may keep the client's responsible executives from using the consultant's suggestions. These are: lack of mutual understanding, lack of a desire by the client's executives to see a change come about, and lack of an objective outlook on the company problem by these executives. Lack of mutual understanding is the most important factor because it also affects any problems that may exist in the other areas.

Since the client's responsible executives are key men in the success of any consulting engagement, the first step in the opening of each new negotiation must be to establish an atmosphere of understanding. In those situations where the executives have positive attitudes, this will be easily accomplished. It will lead directly to the development of a constructive program for the client.

When resistance is encountered, difficulty of attainment cannot serve as an excuse for ignoring this vital relationship. The consultant must respect the outlook of the executives, and they in turn must accept the consultant as a force working with and for them. Without mutual understanding, there can be no certainty of bringing about the change in attitude necessary to the development of an objective outlook and the drive to put a new program into effect quickly and effectively.

Three actual case histories will serve to illustrate the problems encountered. These examples all cover projects where the clients sought out the consultants and requested that new systems be installed in their companies. Cost accounting practices were being considered, but the basic situations that arose and the results that followed are similar to those of other consulting situations. Each relationship was unsuccessful even though the consultants were among the most noted in their field, possessed the technical information needed by the clients, and did their best to put this information to work in the client's firms.

The first relationship began when the vice president of a Massachusetts woolen mill requested a group of prominent management consultants to set up operating standards for the maintenance labor force. They were asked to work with the maintenance superintendent in the establishment and installation of the standards.

After the consultants obtained the information they required through the superintendent, they returned to their home office and worked out a complete, sound, and well-integrated set of performance standards. The consultants then met with the superintendent to plan the installation. They found that the superintendent was opposed to using such a complicated system, preferring to judge performance in the manner he had developed over the years.

During the discussions, the superintendent expressed doubts that the mathematical standards would provide the same results as under his own system, although he did not appear to feel very strongly about the matter. Since the consultants were convinced of the soundness and potential benefits to the company of their proposed system, they were able to break down his arguments and obtain his agreement. The standards were installed and the engagement ended.

Subsequently the consultants learned that the standards fell into disuse in a matter of days. It was then realized that the superintendent never intended to use them. Outraged at this flaunting of reason, the consultant in charge went to the vice president in an attempt to gain his support. The vice president refused to force the standards upon the superintendent.

Causes of Failure

Two factors appear to have contributed fundamentally to the failure of this engagement. One was the lack of understanding as to how the standards would work. The other was the lack of concern on the part of the supervisor as to whether he should have any new standards of evaluation. If the consultants could have understood the fears of the superintendent with respect to the standards, and the superintendent could have seen how the standards would serve him better than his current method, everyone might have profited.

Some consultants, who have experienced failure because of the opposition of clients' subordinates, have been tempted in future relationships to establish an agreement with the client to the effect that suggestions will be installed without the approval of the executives. This is one answer to the problem. But such agreements are not insurance against bit-

ter opposition from executives or a guarantee of the success of the engagement.

Another revolt developed among certain members of the management of a New England power company where the consultants involved appeared to be off to a good start with a virtual guarantee that their program would be installed. During the successful installation of a job evaluation system, the consultants suggested to the president that certain of the accounting work could be mechanized at a great saving. The president decided to adopt the plan. He called a meeting of all the management people who would be concerned and had the consultants present their ideas in a manner similar to that used in starting the job evaluation study.

Those who attended the meeting besides the president were his assistant, the treasurer, the assistant treasurer (in whose department the new methods were to be installed), and the general manager. The only concerned executive absent was the vice president. After the consultants had presented their suggestions the president asked, "Well, we ought to go into it; that is, set up these machines, don't you think?" The answer was a unanimous "Yes." No discussion was encouraged; in fact, the president's question carried a tone of decision.

Assured of support, the consultants proceeded to gather the information they required. The compilation of data and analyses were particularly painstaking and exact since the consultants hoped this assignment would lead into similar work for other utilities. No other work along this line had been done for electric utilities in the area, so there was a good chance of building a reputation. As the investigation progressed the president became more enthusiastic and gave his support to several recommendations for change made by the consultants. An outstanding system was developed and readied for installation in the billing department.

Resistance Develops

It was not until the final preparations for installation were being made that the consultants ran into obvious resistance. After a trial run of the previous month's accounts by both the old system and by the new, the results were compared, and it was found that they were incompatible. Even after several days of detailed checking and rechecking the results from the two methods failed to agree.

The assistant treasurer suggested to the consultants, as well as to others in the company, that he had expected as much and proposed that the whole idea of changing the billing of accounts be dropped as impractical. He insisted the difficulty lay in the mechanized method, while the consultant insisted the assistant treasurer must be at fault. In checking through all of the assistant treasurer's books the consultants discovered that they had not been given all of the necessary information. By incorporating these additional data it was shown that the new system would work. It was decided that one-half of the next month's bills would be put out using the consultant's new method.

At this time the president left for his annual vacation, leaving the vice president in charge. Immediately thereafter, for a period of several days, the assistant treasurer, the treasurer, and the vice president held extended meetings and questioned the consultants on the ability of the new system to put the bills out on time. Repeated assurances by the consultants that all would go better than before were to no avail. Finally, a telephone call to the head of the consulting firm announced that their services were terminated. The consultant appealed to the president, but he vouchsafed only that the system was not considered workable in his company. At a later date, however, another firm installed an essentially similar system which was found to be quite satisfactory.

In this instance the wholehearted cooperation of the man responsible for the implementation of the consultant's suggestions was not considered essential. The consultants did not make the mechanized system understandable to the assistant treasurer, were not interested in the reasons for his resistance to change, and tried to push the plan through by reliance on the president alone. Lack of mutual understanding at all levels made a potentially rewarding relationship end in failure.

COOPERATION WITH THE MEN CLOSE TO THE PROBLEM WILL PROVIDE MUTUAL BENEFITS.

On some projects use of the same approach, with the same disregard for the necessity of reaching an understanding with the responsible executives, may lead to culmination of the contract. Usually the results appear satisfactory, but if viewed in the light of greatest service to the client, are somewhat less than ideal. If, for example, the consultant's suggestions are installed against the wishes of the execu-

GOOD COMMUNICATION BETWEEN ALL PARTIES IS VITAL TO SUCCESSFUL RELATIONSHIPS.

tives responsible for their implementation, the internal structure of the company may become weakened and incapable of supporting the new methods.

One New Jersey manufacturing concern received mixed benefits from the assistance of a group of consultants who helped establish wage incentives. These consultants were of the "I am the doctor, so don't question my advice" type. Their approach was to tell the president what was needed without any "fooling around or sugar coating," as the partner put it. The president agreed to accept the consultants' advice and install the wage incentives.

Incentives were subsequently worked out by the consultants independently of company executives, reviewed by the president, and put into practice by the appropriate group in the company. The installing supervisor was not in a position to obstruct the consultants overtly, but his dissatisfaction led him into an attitude of apathy and indifference towards the standards and their maintenance.

As a result, an impasse has developed. Each succeeding year the president has requested the consultants to return, bring the system up-to-date, and check on its administration. He has never since relied upon his own employees, despite the fact that the consultants insist the supervisor is fully capable of managing the incentives. Since the supervisor did not contribute to the initial installation and has never been given responsibility, he feels his suggestions are not desired. He has erected a defense of indifference to protect his injured self-esteem and lack of understanding of the system.

On each of these three projects the consultants performed many of the duties essential to a successful engagement, such as discussing fees, insisting upon a definition of the problem, and developing inspired solutions. But, they were unable to develop a good relationship with certain members of the client's management who were later to be responsible for the installation and execution of their suggestions. As a result of this failure to enlist support of these key men, the projects were unsuccessful.*

Preconceived Attitudes

Why is mutual understanding between the consultant and the key men so often lacking? One basis for the development of misunderstanding may exist even before the consultant arrives. The responsible executive may fear the consequences to follow from the investigation, and may develop a decidedly unrealistic picture of what the consultant's motives are and what he plans to do. Under such conditions the initial statements and actions of the consultant can be easily misinterpreted—even viewed by the executive as threats.

Competent consultants do not desire — or need — to reduce the authority of responsible executives. They recognize this fundamental as a prerequisite to the development of mutual understanding. However, the executives may still harbor the suspicion that they will suffer from a change in the activities for which they are responsible. For example, a consultant may appear to an executive to be following a "let the chips fall where they may" approach to the company's problem. The consultant meanwhile may consider himself to be proceeding with an objective examination of the facts, to be followed later by consideration of company peculiarities and personalities in the development of a recommendation. If preconceived attitudes are held by the executives, they may subconsciously twist a chance

*For similar cases see Dunn, Albert H. III, *Business Consultants; Their Uses and Limitations,* Controllership Foundation, Inc., 1951

remark, or the most carefully-worded statement, of the consultant into a meaning that arouses further prejudice and fear.

Even when preconceptions are absent — or favorable — the consultant cannot expect that all of his statements during first meetings will be understood as he intends. Usually he is a stranger to the company, and possibly to the industry's terminology and customs. He may also have an educational, geographical, or social background that differs from that of the executive.

Misunderstanding is Easy

These differences, and any possible preconceptions, combine with other problems of personality and circumstances to make communication between strangers exceedingly difficult. In fact, many studies (including experiments conducted by the MIT Industrial Relations Department) bring out forcefully that messages considered explicit and clear by the sender, often are misinterpreted. The difficulties encountered in exchanging the simple content of the messages in these experiments gives an indication of the ease with which the consultant may be misunderstood in attempting to communicate abstract ideas and complex procedures.

Actually, the consultant may himself block the development of mutual understanding by viewing self-righteously the biased views of the executives, or by inadvertently giving rein to his own prejudices. He might easily reject the executive's opinions or feelings on the basis that he is simply "a solid wall of cultivated prejudice and inherent stupidity." The executive may be all of this, but if he is to remain a responsible member of the client's organization, his biases and fears must be taken into account — even if they are not understood.

The prejudices of the executives may be so complex and based upon such an unusual scale of values that the consultant cannot hope to comprehend them. Fortunately, however, an executive's concern usually can be rationalized if it is recognized that his feelings are based, quite normally, upon fears that everyone at times entertains. He may wonder whether he will have the intelligence to utilize the system the consultant is proposing; whether he will be reduced in stature (either actually or in the eyes of his fellowworkers); or whether he will even be needed if the new system is installed.

Thus, the consultant often finds himself with the responsibility for developing harmonious relationships between himself and several strangers who may be prejudiced and may not understand him. He can hardly afford to barge in with a shotgun technique designed to establish rapport. What steps can be taken to develop understanding? The consultant's approach must be based upon concern for the interrelations which exist within the company and an awareness of the obstacles that stand in the way of understanding. He must reconcile the various conceptions of the company's problem, his own motives, and a solution to the company's problem. In practice each of these steps will build upon the previous one, with each bit of understanding gained by the consultant or executive catalyzing the development of more.

Interviewing techniques are extremely important in determining the feelings of the executives about the company's problem. The consultant needs to break through the amiable, general, or somewhat evasive statements often used by executives to avoid arousing antagonisms. A start can be made by picking up and discussing incongruous, biased, or deprecatory remarks, rather than allowing them to slip by at face value, or simply noting them as an indication that something or someone is wrong.

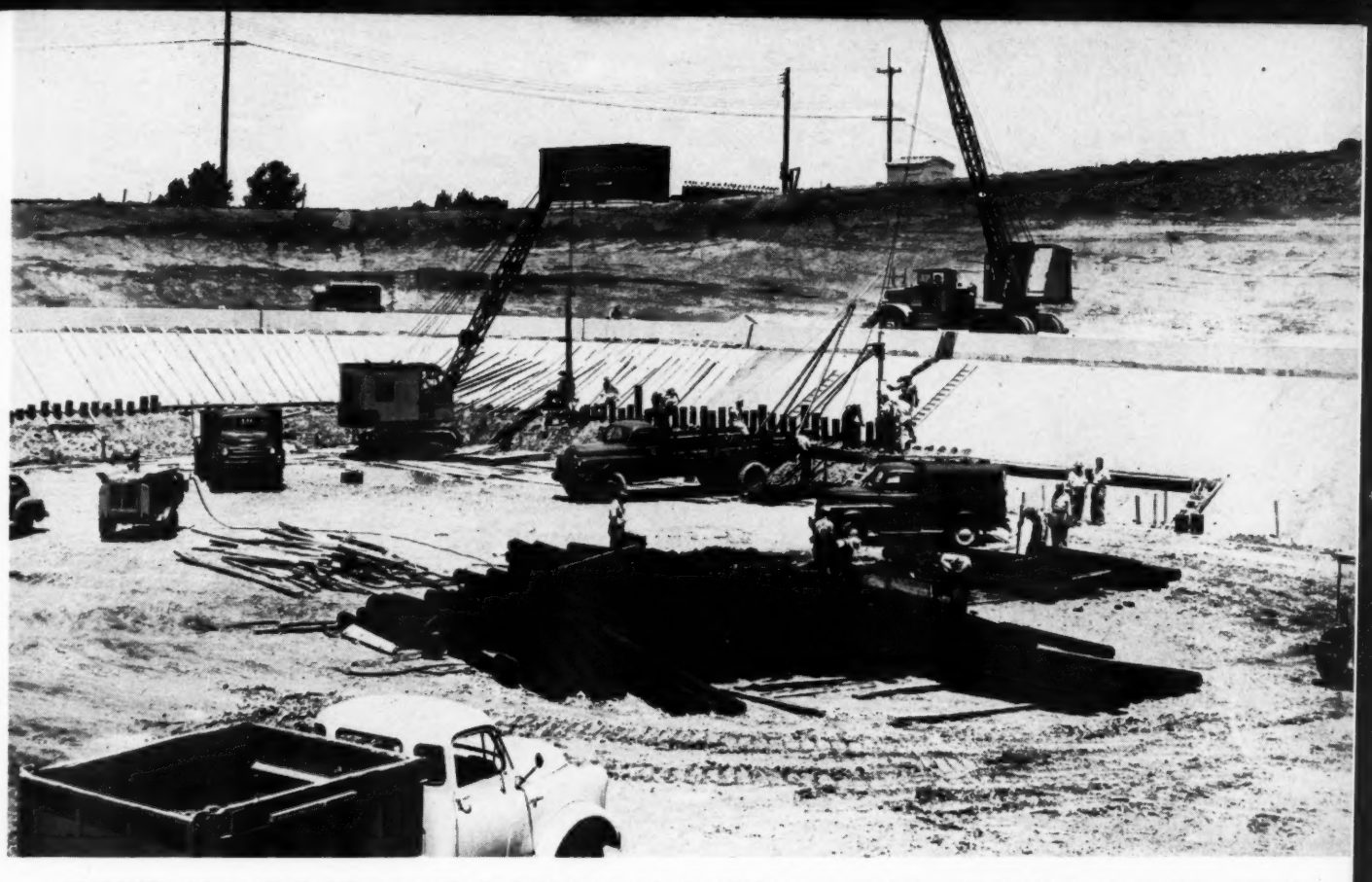
Initially the consultant has little idea of what connotations will be placed upon his statements and actions. As he gains insight into the feelings or prejudices of the executive he can establish a basis for correctly communicating his ideas. To a certain extent the consultant develops into his own interpreter, using a different language for each person.

One method that will improve a consultant's chances of being understood by the executive is to invite a response detailed enough to indicate whether the correct interpretation was made. In addition to assuring that the correct interpretations are made by the executive, incorrect interpretations reveal any change in the attitudes held by the executive. When they are incorrect the consultant then can shift from an explanation of his meaning to a clarification of the new prejudice.

Tactfulness is of paramount importance. Often when the consultant is misunderstood there is a natural tendency to carefully point out to the other person exactly what was meant and how the erroneous interpretation was made. If the consultant is insistent that the executive listen once again to exactly what he said, especially early in the engagement, it may prove disastrous. The executive may well get the impression that the consultant has not come to work out jointly how things should be done, but rather that he is there to forcefully dictate.

Success Assured

When each party attains a measure of insight into the other's viewpoint the success of the engagement is virtually assured. As the proposal is being developed it will be possible for the consultant to understand and appreciate the merits of suggestions and criticisms offered by the executives. In addition, by following a program of mutual understanding that attempts in every detail to further develop the client's organization, at least one major criticism of consultants can perhaps be avoided. There will be fewer opportunities for executives to say, "Those consultants' suggestions may be all right for some companies, but they won't work in ours!" ▲▲



CREOSOTED WOOD PILES WERE PLACED IN THE BANK TO INCREASE THE SLOPE'S RESISTANCE TO SHEAR. PILING WAS SELECTED INSTEAD OF A SOLID RETAINING WALL BECAUSE IT PERMITS DRAINAGE OF THE GROUND WATER.

Stabilizing the Bank of an Open Water Reservoir

E. L. SCRUGGS
Vice President and Chief Engineer
The Springs Cotton Mills

Ce exclusive

The Chief Engineer of The Springs Cotton Mills tells how the expert advice of consulting engineers helped overcome unexpected difficulties encountered during construction of a 3 million gallon water reservoir.

THE UNEXPECTED is frequently encountered during engineering work, particularly when dealing with underground conditions. This point was fully, but expensively, exemplified when the engineers of The Springs Cotton Mills undertook the construction of a 3-million gallon water storage reservoir at the Grace Bleachery, Lancaster, S. C.

About six years earlier, a 5-million gallon storage reservoir of similar design had been built adjacent to the site of the new project. There was no reason to believe ground conditions would be dissimilar.

The reservoir was to be of open design, using a conventional-type Gunite lining. Fortunately, it was decided to construct the bottom of the new reservoir five feet above that of the old reservoir. The higher elevation was decided upon simply as a matter of economy—not with any thought of encountering foundation difficulties.

During the excavation work, water was encountered in one corner of the reservoir at grade, and a very soft spot developed at this point. As fine grading of the slope progressed prior to applying the Gunite surfacing, it was noticed that cracks were developing in the finished slope. Evidence of ground movement where the cracks developed indicated considerable ground water pressure.

It soon became evident that the original design,

BECAUSE OF THE UNSTABLE CONDITION OF THE SLOPE, THE PILING WAS PLACED BY BORING HOLES FOR THE PILES AND BY USING A DROP HAMMER TO DRIVE THEM THE LAST FEW FEET.

calling for a 2½-in. Gunite surfacing, was entirely inadequate. It also became quite clear that an accumulation of ground water behind the slope might prove disastrous.

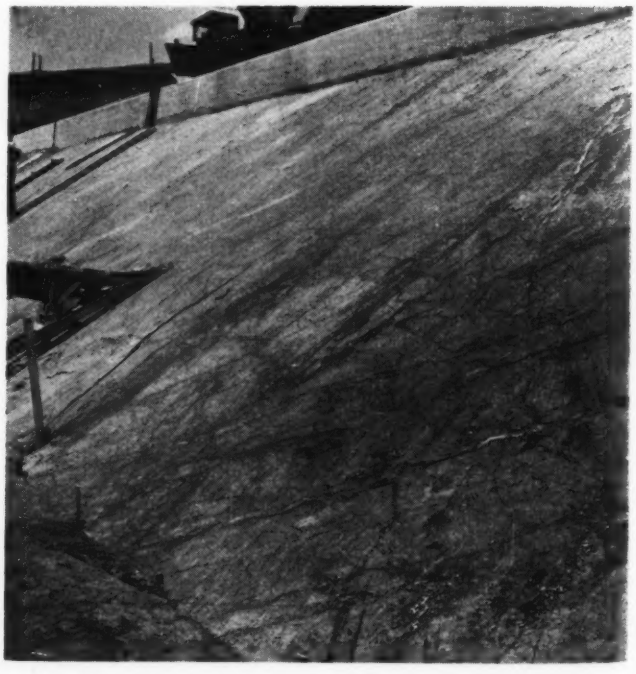
Consulting Engineers

Since the need for corrective action was urgent, the J. N. Pease & Company, consulting engineers, of Charlotte, N. C., who were doing work for The Springs Cotton Mills at the time, were called into consultation. At the same time Professor George F. Sowers, Consulting Soils Engineer for Law-Barrow-Agee Laboratories, Inc., Atlanta, Ga., also was called in for consultation. Mr. Halfhill of J. N. Pease and Professor Sowers, together with the engineers of The Springs Cotton Mills, made a thorough examination of the soil conditions. Professor Sowers took samples of the soil for laboratory analysis.

Professor Sowers also called in G. G. Schofield, of Robert & Company Associates. This firm had handled the engineering on most of the work in this immediate area, and were familiar with the soil conditions and with other structures at this site.

It was found that the soil was a loose, brown and gray, fine, sandy-clay silt. This is a residual material derived from the in-place decomposition of the granite-gneiss bed-rock which underlies the region. The rock is extremely old (probably Pre-Cambrian in age) and has been subjected to extensive faulting and the intrusion of narrow dikes of different minerals. These defects are present in the weathered rock in the form of planes of weakness and discontinuity. Some of the faults are actually minute cracks which permit the slow seepage of water.

Tests were made of undisturbed samples of the soil to determine their physical properties. The porosities ranged from 53 to 56 percent, and the water contents varied from 39 to 46 percent. The average angle of shear resistance was 15 degrees. The soil cohesion varied from about 700 lb per sq ft when



CRACKS AND GROUND MOVEMENT IN THE FINISHED SLOPE INDICATED SERIOUS GROUND WATER PRESSURE.

the soil was drained to only 50 lb per sq ft when the soil was inundated. These tests were made on portions of the soil not affected by the fault planes. Some portions of the soil have even less strength. A stability analysis indicated that the soil shears along curved surfaces which are theoretically similar in shape to an elongated, deep saucer.

Recommendations

Professor Sowers' comments on this particular type of failure were: "Correction of such a failure can be of two types: flattening the slopes or increasing the resistance to shear along the curved surfaces."

Since flattening the slopes was impractical, it was decided to increase the resistance to shear.

Professor Sowers' also stated that, "Since the soil's cohesive strength was reduced by inundation, drainage is one method of stabilization. Drainage cannot correct the strength lost by previous shear failures and it may not be completely successful during periods of high ground water level.

"A retaining wall can support some of the soil weight and thus supplement the soil's own shear strength. Structurally a solid wall such as sheet piling could augment the shear resistance of the soil and insure stability. From the hydraulic point of view, however, the sheeting would prevent free drainage of water and would cause a build-up of water pressure and a loss of soil strength."

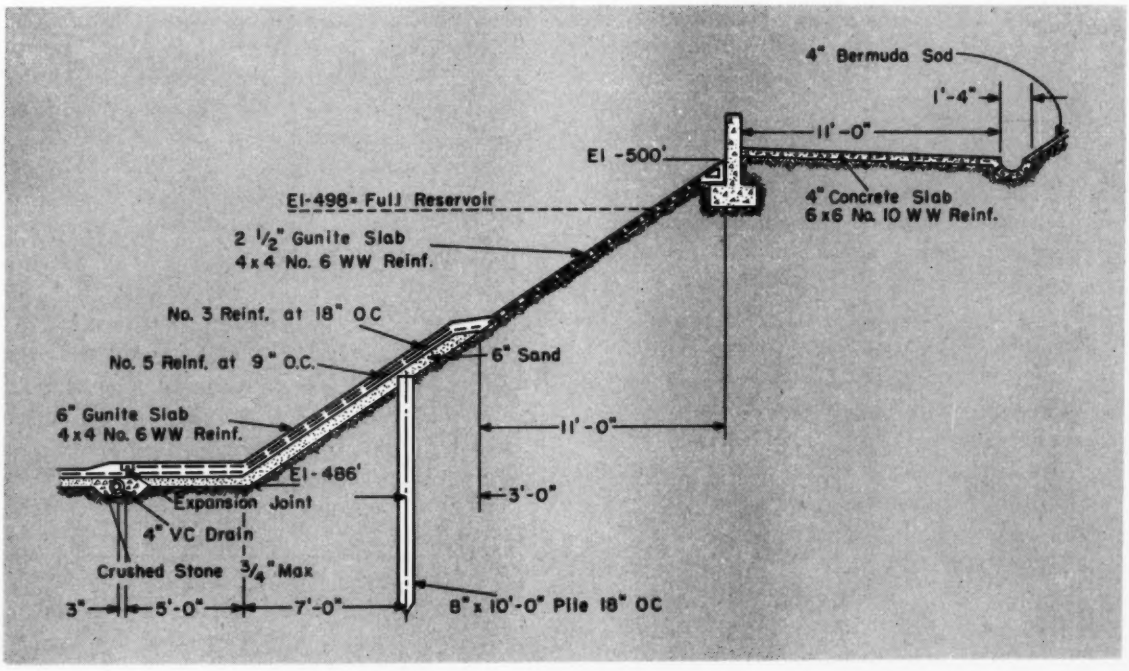
It was therefore decided to use wood piles to obtain the necessary support without obstructing drainage. Creosoted piles, 8 inches in diameter and 10 feet long, were placed on 18-in. centers at the point of greatest pressure—about 7 feet from the toe of the bank.

Because of the bank's unstable condition, the piles could not be safely driven in the usual way. Instead, a hole boring machine was used to bore 9-in. holes to a depth of about 8 feet. The piles were then placed in the holes and driven down with a 2000-lb drop hammer.

To provide drainage for any water that might accumulate back of the Gunite lining, a 6-in. gravel base was used for the entire bottom of the reservoir. Also, a 6-in. sand drain was used for the lower one-third of the slope. This section was strengthened by using a 6-in. thick reinforced concrete section instead of the normal 2½-in. Gunite lining used throughout the rest of the reservoir.

A 4-in. vitrified clay pipe was installed approximately five feet from the toe of the bank to drain off any water accumulating from either natural drainage or leakage from the reservoir. This pipe is connected to the general drain for the reservoir by a cast iron pipe, valved at the reservoir end. With the valved arrangement, if excessive flow should develop, particularly if it carries suspended solids, indicating a break in the reservoir lining, the drainage system can be cut off to prevent back flow while the reservoir is being drawn down for inspection and repairs.

The reservoir was filled in July of this year and has thus far functioned perfectly. No sign of excessive seepage or further evidence of distress has occurred. ▲ ▲



A GRAVEL BASE UNDER THE BOTTOM SLAB AND A SAND DRAIN FOR THE LOWER PART OF THE BANK ALLOW GROUND WATER TO DRAIN TO A CLAY PIPE AROUND THE RESERVOIR'S CIRCUMFERENCE.

PROJECTED PROFIT AND LOSS STATEMENT

Item No.	Item	Comments	Annual Cost or Profit
(1)	Estimated net sales	Assumed to be known from previous estimate	
(2)	Estimated cost of sales	Assumed to be known from previous estimate	
(3)	Estimated gross profit	Item (1) less Item (2)	
(4)	Estimated administrative and selling expense	Assumed to be known from previous estimate	
(5)	Profit before fixed charges	Item (3) less Item (4)	$719,500
(6)	Fixed charge calculations		
	(a) Property tax & insurance	1% of capital cost*	10,000
	(b) Average interest on investment	4½% of the outstanding balance	40,500
(7)	Depreciation @ 4% of capital cost (25 years)**		40,000
(8)	Profit before income tax	Item (5) less Items (6) & (7)	$629,000
(9)	Federal and state income tax***		
	(a) State income tax	3% of Item (8)	19,000
	(b) Federal income tax	52% of Item (8) less Item (9a)	317,000
(10)	Annual net profit after taxes		$293,000
(11)	Add back depreciation	From Item (7)	40,000
(12)	Annual net cash return		$333,000

* Rate shown is an illustrative example only.

** The allowable depreciation period may be as low as 15 or 20 years. Cost of land is excluded from the capital cost when calculating the depreciation allowance.

*** Income tax rates for the various states of the United States differ. This example uses 3 percent only as an illustrative rate. Federal income tax rate shown is the 1954 rate for corporations with profits in excess of $25,000 per year.

Profitability Calculations Simplified

SAM RUVKUN, Kaiser Engineers

CE exclusive

Sam Ruvkun is assistant to the vice president and general manager of Kaiser Engineers. He conducts engineering-economic investigations, surveys, and evaluations of projects in basic industries. For example, Ruvkun made an analysis of process development, plant layout, markets, investment potential, and profitability projections for the utilization of wastes from the pulp industry. He spent two years in the automobile industry making budget forecasts for plant operations, cash forecasts, profit and loss forecasts, analysis of assembly line procedures, and economic evaluations of proposed improvements. He was an officer in the U. S. Navy and served as a construction superintendent with the Seabees. He is a civil engineering graduate of the University of California. Ruvkun belongs to the ASCE, Tau Beta Pi, and Chi Epsilon. He is a registered professional engineer in California and Michigan.

CONSULTING ENGINEERS generally have responsibility for estimating construction costs and costs of sales* (operating costs) in conjunction with engineering service. They often are also requested to recommend whether or not a proposed venture should be undertaken. To make this recommendation, the consultant must pass on the profitability of the venture.

A common way of expressing such profitability is in terms of the number of years over which the initial cash investment is paid back. This time is the "payout time." It is the number of years during which cash is accumulated from profits to equal the original investment, after all operating costs are paid, all allowable deductions are made for fixed charges, and an allowance is made for income tax payments. "Fixed charges" refer to interest on bor-

*Labor, material, supplies, manufacturing overhead.

Tax law effective next March changes tax from 52 to 47% and permits accelerated depreciation rate. Numbers in adjoining computations would change but effectiveness of the method remains valid.

rowed funds, property taxes, and fire insurance. For purposes of this article "fixed charges" do not include depreciation.

In profitability calculations, consulting engineers must recognize the importance of income tax payments. Under current Federal income tax laws, corporations pay Federal income taxes at the rate of 52 percent of profits in excess of $25,000 per year, after all allowable items of cost are accounted for, and after depreciation allowances are made. The income tax reduces profits available to pay for the investment to the extent that the payout time becomes twice what it might otherwise be.

Yet, income taxes are often erroneously omitted from profitability calculations. Such omission prior to World War II introduced a relatively minor error in the calculations. The Federal income tax rate in 1938, for example, was 19 percent of earnings before income taxes. Now that Federal and state income tax rates are considerably higher, such errors of omission have greater effect.

The financial and cash needs of management must be known for the period over which a new investment must be repaid. After the markets have been properly surveyed, after the plant has been laid out, after construction costs have been estimated, after cost of sales have been estimated, and after administrative and selling expenses have been estimated, the calculations for profitability follow.

Projected Profit and Loss

A convenient form for the presentation of pertinent data is a "Projected Profit and Loss Statement." It portrays how today's estimates establish tomorrow's profits—if and when the project is authorized.

After years of evaluating proposed new ventures, a simplified format has been developed. An example illustrates how the information is used. Assume the following:

¶ For a new venture, an additional investment of $1,000,000 will be required for new plant and equipment. Assume no new land is required and no additional working capital is required.

¶ The markets have been properly surveyed.

¶ The new facilities have been laid out.

¶ Construction costs have been estimated.

¶ Cost of sales has been estimated.

¶ Administrative and selling expenses have been estimated.

¶ Assume, for purposes of the example, that "Profit Before Fixed Charges" has been derived from previous estimates.

The Projected Annual Profit and Loss Statement for this proposed investment is set up as shown by the computation on the preceeding page.

In the example, the investment in plant and equipment was assumed to be $1,000,000. The Projected Profit and Loss Statement shows an annual net cash return of $333,000. The payout time is thus three years.

Consider now the fallacy of omitting the income tax calculation. Annual profit before income tax is shown as $629,000, but the actual annual net cash return as finally computed is $333,000. If profit before income tax were used to justify the economic feasibility of the project, misleading determination of the payout time would be obtained. The "answer" obtained would be 90 percent away from the truth, and entirely outside of the range of accuracy to be expected from profitability calculations. Certainly, all other cost estimates have better accuracy than 90 percent error!

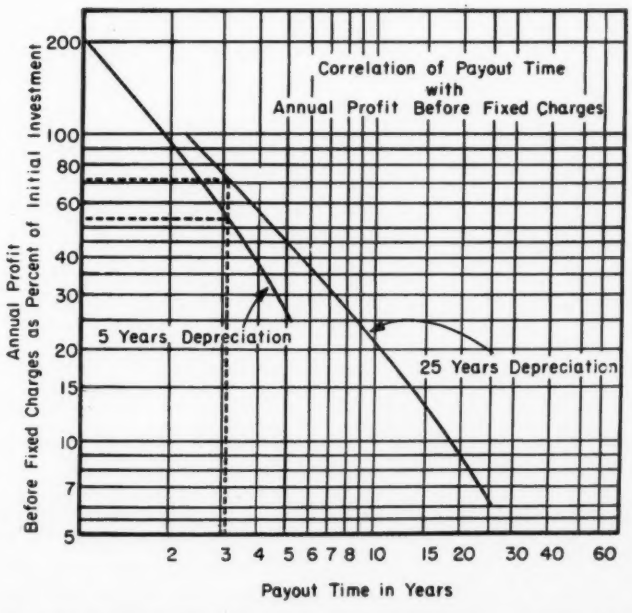
Graphic Presentation

A correlation between "payout time" and "annual profit before fixed charges" has been plotted on the graph just below. A series of Projected Profit and Loss Statement calculations have been prepared for payout times of from 1 to 25 years.

For simplification, the initial investment is assumed to include additional plant and equipment with no allowance for additional land requirements or new working capital. In the preparation of profitability calculations for a given set of conditions, care must be taken to avoid depreciating the value of land and working capital; on the other hand, the *entire* investment must be considered in calculating payout time.

On the graph, the upper curve for a 25-year depreciation period approaches a straight line and thus its use for interpolating results is simplified. Because the plot is made on log-log paper, the data is depicted in a relatively small area.

The dotted lines indicate the method of using



GRAPH CORRELATES PAYOUT TIME AND ANNUAL PROFIT BEFORE TAXES FOR A GIVEN SET OF CONDITIONS.

COMPARATIVE PROJECTED PROFIT AND LOSS STATEMENT

Item No.	Item	Annual Cost or Profit Scheme A	Annual Cost or Profit Scheme B	Annual Savings of Scheme B Over Scheme A
(1)	Estimated net sales 100,000 stampings @ $5.00/stamping	$500,000	$500,000	
(2)	Estimated cost of sales	280,000	245,000	$35,000
(3)	Estimated gross profit	$220,000	$255,000	$35,000
(4)	Estimated administrative & selling expense (assumed to be negligible)	—	—	—
(5)	Profit before fixed charges	$220,000	$255,000	$35,000
(6)	Fixed charges			
	(a) Property tax & insurance @ 1% of investment	1,500	2,000	(500)
	(b) Interest on investment @ 4½% of outstanding balance of investment	10,000	13,000	(3,000)
(7)	Depreciation 6.67% (15 years on investment)	10,000	13,300	(3,300)
(8)	Profit before income tax	$198,500	$226,700	$28,200
(9)	Federal & State income tax			
	(a) State income tax @ 3% of Item 8	$ 6,000	$ 6,800	$ (800)
	(b) Federal income tax @ 52% of (8) less (9a)	100,100	114,300	(14,200)
(10)	Annual net profit after taxes	$ 92,400	$105,600	$13,200
(11)	Add back depreciation	10,000	13,300	$ 3,300
(12)	Annual net cash return	$102,400	$118,900	$16,500

the chart. Assume an investment in plant and equipment of $1,000,000 for a new venture. Assume that management desires the return of its investment in a three-year payout time. On the X-axis, advance to the three-year payout time. Project upward to the curve for 25-year depreciation. Project horizontally to the vertical scale. For this case, the annual profit before fixed charges is 72 percent of the initial investment.

Having assumed an initial investment of $1,000,000, the annual profit before fixed charges is $720,000—which agrees with the first calculation of the Projected Proft and Loss Statement.

Another example is shown by the lower curve. Assume that the investment is again $1,000,000 and that 5-year depreciation is allowed. Assume management wants its investment returned in three years. Annual profit before fixed charges is found from the graph to be 54 percent of the initial investment—or $540,000. In other words, for a three year payout time with a 5-year depreciation allowance, some $180,000 less is paid out as income tax than for a 25-year depreciation period. This means that the annual gross profits required to meet the conditions set up by management are $180,000 per year less with the short depreciation period compared with the longer period.

Estimate Payout Time

This graph is also a convenient method of quickly picking off the order of magnitude of payout times when profits before fixed charges have been estimated. Levels of profits may be estimated from a series of forecasts of sales volumes or of sales prices. The payout period then can be found for any particular forecasted sales volume or price corresponding to the calculated profit.

The curves are valid only for the 25-year and 5-year depreciation periods covered. The curves cannot be used for a payout time longer than the depreciation period since the curves discontinue at the end of the depreciation period. Within these limits, curves can be plotted for other depreciation periods by making a series of calculations similar to the Projected Profit and Loss Statement.

Expanding Businesses

These profitability calculations are equally applicable to analysis of investments by new businesses and for expansion of existing businesses. Often, the decision to be made is whether an expanded operation is more profitable than the existing operations. The approach to such a decision requires careful comparison of present profits and the anticipated profits after the expansion.

The additional profit, calculated by taking the difference between a profitability projection and present profits, will lead to the answer as to how much additional net profit will come in. This can then be related to the new investment requirements, and a payout time can be derived. This type of an analysis would readily show, for example, how an expanded operation would save on overhead costs or material handling costs. By detailed comparative analysis, all significant factors are considered and the answers so obtained have real meaning.

Comparing alternate methods of expanding an operation should follow the steps of preparing a Projected Profit and Loss Statement. For comparing Scheme A versus Scheme B, the best approach is to prepare two Projected Profit and Loss Statements and to arrange them in tabular form for easy comparison. (See calculations above).

It has been said that for comparing two schemes of operations, there is no need to include the item of income tax. This may be true only if the differ-

ence in investment is little. However, to properly evaluate which is the most "profitable," considering all factors of investment and profit, one must proceed more systematically. The payout period is a convenient means of making the comparison.

Assume, for example, that Scheme A for producing 100,000 metal stampings per year requires an investment of $150,000 for equipment. The sales price of stampings is established at $5.00 each and the cost of sales is estimated at $2.80 each.

Under Scheme B, the 100,000 metal stampings can be produced faster, but additional equipment will cost $200,000. The cost of sales can be cut to $2.45 each. The comparative Projected Profit and Loss Statements are shown in the adjoining columns.

Additional Cash Generated

This analysis shows that Scheme A has a payout time of 1.46 years and Scheme B has a payout time of 1.68 years. The additional investment in Scheme B over and above that in Scheme A pays out in 3.03 years. If these calculations had been prepared on the basis of comparing gross profits only, they would have revealed an additional gross profit of $35,000 per year versus an additional investment of $50,000. But the real additional cash actually generated by the extra investment in Scheme B is only $16,500 annually, after taxes.

This analysis does not necessarily indicate that the additional revenue is unattractive, but that Scheme B is less profitable by comparison than Scheme A. The decision as to how attractive the increment between Scheme A and Scheme B would be depends on what other opportunities are available to management's funds for improvement or expansion — taking into account the comparative payout times of these alternatives.

Establishing a Price

The Projected Profit and Loss Statement can be used to derive a required sales price if the cost of sales, cost of facilities, and other data have previously been determined. The method is to first establish a desired payout time in years, then calculate the profit required to meet such a payout time, next establish the total net sales revenue requirements by adding in the cost of selling and cost of sales, and finally divide the net sales revenue by the number of units to be produced. This method of deriving unit selling price can be shown by example. (See calculations below.)

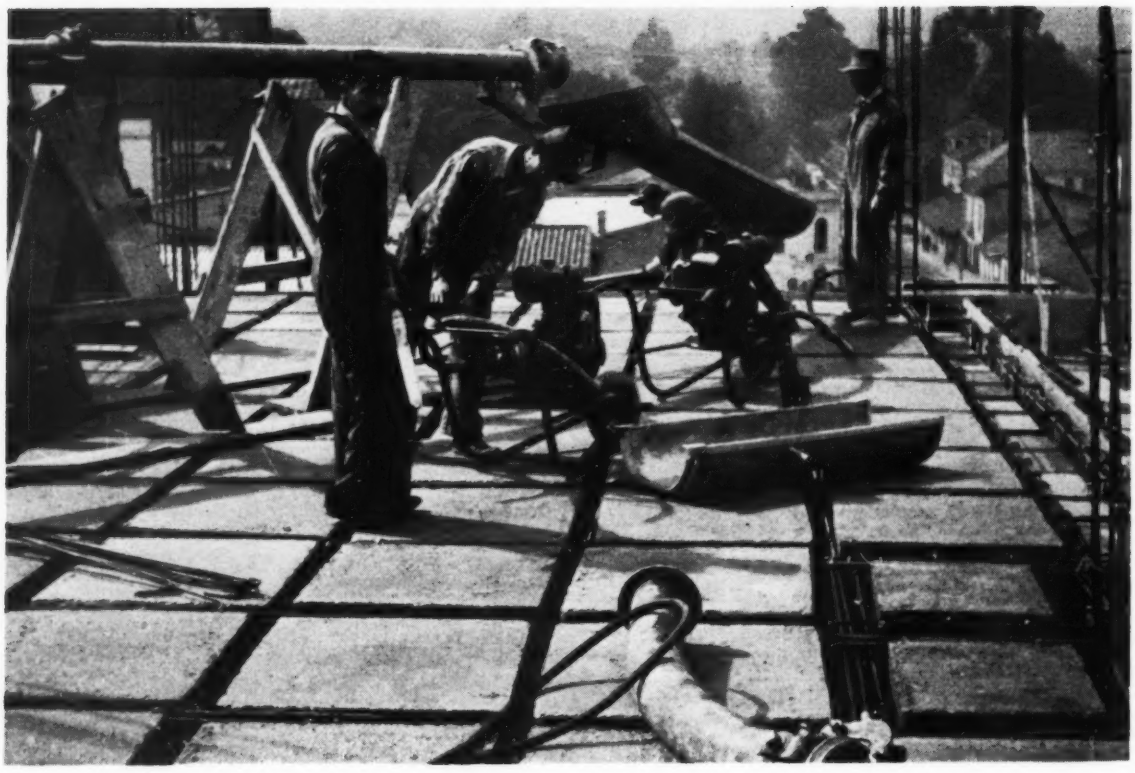
Suppose that the Ajax Flypaper Company wishes to expand its operations by selling industrial flypaper. A proposal submitted by the sales department indicates that there is a ready market for flypaper. Independent market analysts agree with the market survey. A consulting engineering firm is hired to prepare preliminary flow sheets and preliminary plant designs, make equipment selections, estimate the cost of facilities, estimate the cost of sales, estimate administrative and selling expenses, and recommend a price for the product.

Assume production will be 1,000,000 cartons per year. Assume that plant and equipment costs are estimated at $1,000,000. (For simplicity in this example, again omit the value of land and neglect

—Continued on page 72

RECOMMENDED SALES PRICE

Item No.	Item	Comments	Annual Cost or Profit
(12)	Annual net cash return	Assuming 3-year payout on $1,000,000 investment	$ 333,000
(11)	Add depreciation		40,000
(10)	Annual net profit after taxes		$ 293,000
(9)	Federal & State income tax		
	(a) State income tax	3% of Item (8)	19,000
	(b) Federal income tax	52% of Item (8) Less Item (9a)	317,000
(8)	Profit before income tax	Note that Item 8 can be calculated after Item 10 is known by first dividing Item 10 by 0.97 to allow for state income tax of 3%, and then dividing that result by 0.48 to provide for Federal income tax at 52%	$ 629,000
(7)	Depreciation	4% of capital cost	40,000
(6)	Fixed charges		
	(a) Property tax & insurance	1% of capital cost	10,000
	(b) Interest on investment	4½% of outstanding balance	40,500
(5)	Required profit before fixed charges		$ 719,500
(4)	Estimated administrative & selling expense	Calculated by the consultant: 1,000,000 cartons @ 5¢/carton	50,000
(3)	Estimated required gross profit		$ 769,500
(2)	Estimated cost of sales	Calculated by the consultant: 1,000,000 cartons @ 35¢/carton	350,000
(1)	Estimated net sales revenue		$1,119,500



CONCRETE IS POURED BETWEEN THE PAN BLOCKS IN A CONTINUOUS OPERATION. TESTS OF CELLULAR SLABS SHOW THAT DEFLECTION CORRESPONDS TO A DOUBLE-T MONOLITHIC BEAM.

The Cellular Slab — Greater Strength at Lower Cost

CE exclusive

DR. DOMENICO PARMA, Chief Engineer
Cuellar, Serrano, Gomez & Cia, Ltda.

Born in Chiavari, Genoa, Italy, Dr. Domenico Parma graduated as a civil engineer from the Superior School of Civil Engineering in Genoa. After moving to South America in 1946, he accepted an engineering position with the Bureau of Building Permits of the City of Bogota, Colombia. In 1947, he joined Cuellar, Serrano, Gomez & Cia, Ltda., an engineering and architectural firm from Bogota, and was promoted to chief engineer in 1948. During the past four years he also has served as an associate professor of civil engineering in the National University at Bogota.

USING PREFABRICATED concrete pan blocks and concrete poured on the site for floor slabs, Cuellar, Serrano, Gomez & Cia, Ltda., engineers and architects of Bogota, Colombia, have increased column spacing without excessive increases in cost.

The reticular cellular slab, as Cuellar prefers to call the method, is constructed in substantially the same manner as the conventional flat slab, retaining all the advantages inherent to concrete construction. The system employs prefabricated pan blocks constructed of 3000-psi concrete. Open at the top and built without bottom flanges, they are used in pairs to form hollow blocks.

Formwork is similar to that used for a conven-

tional concrete floor, except that the cellular system costs less. It requires only a simple flat surface made up of standard length boards or steel forms.

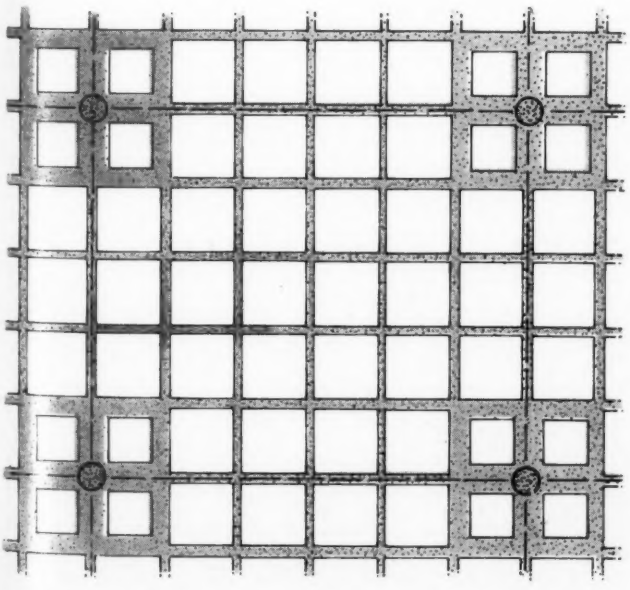
Construction

The lower halves of the pan blocks are placed on the platform with a predetermined spacing between each block. Reinforcing steel is then placed in the spacing between the blocks and is tied together. Holes are punched for roughing-in of plumbing and electrical fixtures. The pattern is completed with the upper halves of the pan blocks. Concrete then is poured between the blocks from the top in a continuous operation.

The sidewalls of the pan blocks are purposely made very rough to insure a good bond between the poured concrete and the blocks. Also, the network of concrete beams poured on the site develops the usual shrinkage as compression against the blocks, thus improving the bond. The resulting slab can be considered as a monolithic unit acquiring the characteristics of a double-T beam. Tests of the deformation and failure in test slabs, made by Cuellar, have indicated that deflection corresponds to sections of double-T monolithic beams.

Two or more sizes of blocks can be used to provide different widths of the poured concrete beams so as to increase the resistance wherever it is most needed. For example, smaller blocks can be used around the columns, thus providing wider beams to resist the stresses occurring at this point.

Pan blocks used by Cuellar have been standardized in six sizes: 34 x 34 in., 34 x 30 in., 34 x 26 in., 30 x 30 in., 30 x 26 in., and 26 x 26 in. The height of the blocks varies from 4 to 10 in., thus allowing thicknesses of slabs between 8 and 20 inches. The average



SMALL PAN BLOCKS ARE USED AROUND THE COLUMNS TO FORM WIDER BEAMS FOR INCREASED STRENGTH.

SLIGHT INDENTATIONS IN THE FINISHED FLOOR ARE CAUSED BY SHRINKAGE OF POURED CONCRETE.

sidewall thickness of the blocks is ⅝ in., and the bottom thickness varies from ⅝ to 1¼ in.

Resistance to failure under a superficial load for a pan block of 34 x 34 in., after placing it in a slab, has been reported by Cuellar as 2200 lb, distributed over an 8 x 8 in. area in the center of the block. The bottom thickness of the block tested was ⅝ in. Resistance for a block with a bottom thickness of 1¼ in. is 4400 lb.

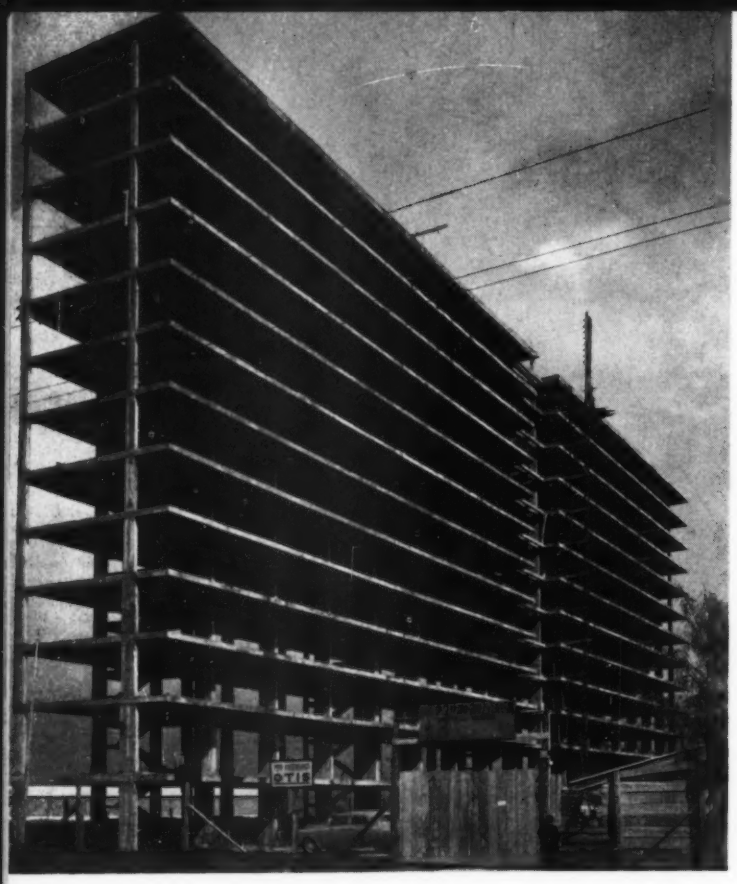
Theoretically the bending moment and the shear stresses of a reticular cellular slab are relatively low and are distributed over a large area, while conventional slabs have a high bending moment, and shear is concentrated upon small areas (upon the beams).

Advantages

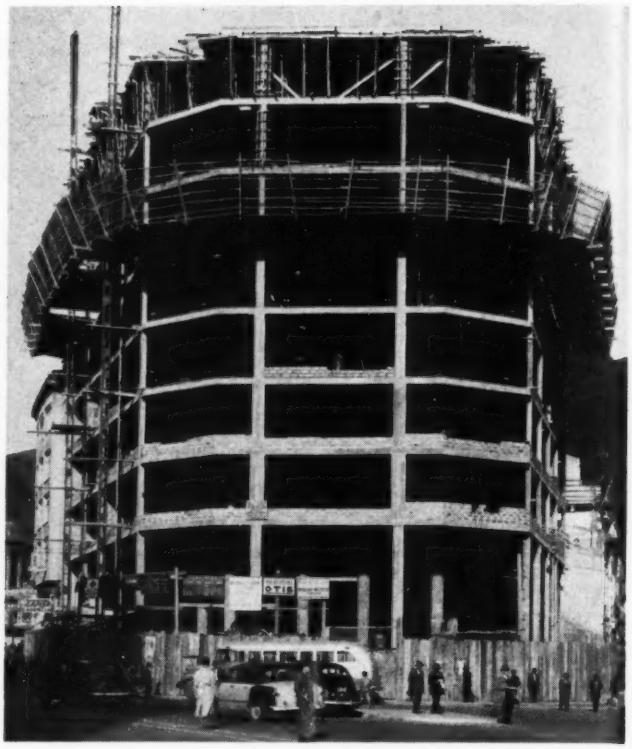
The reticular cellular method of constructing concrete floor slabs offers, as its principal advantage, a satisfactory solution to the problem of obtaining greater distances between columns without an excessive increase in costs. Slabs can be made thicker, with a corresponding increase in resisting capacity, merely by making the sidewalls of the pan blocks higher. The thickness of the slab is increased without a proportionate increase in weight.

A significant saving of materials also favors the reticular cellular system. For a distance between columns of about 20 feet, the materials required for a square foot of slab are about .26 cubic feet of poured concrete, .16 cubic feet of concrete for the pan blocks, and 2.24 pounds of reinforcing steel.

Since the method provides a very light structure, without sacrificing rigidity, it not only saves material in the construction of the slab but also in the supporting columns and foundations. The small quantity of concrete poured at the site allows certain economies, and the pan blocks simplify handling as compared to systems using completely prefabricated elements of greater size and weight. The maximum weight of the pan block is 110 pounds. Since the pan blocks are of a relatively large size, and the beams to be poured are at some distance from each other, a lesser number of large reinforcing



SKELETON OF 13-STORY APARTMENT IN BOGOTA WAS COMPLETED IN 60 DAYS USING CELLULAR FLOORS.



THE NATIONAL CITY BANK BUILDING IN BOGOTA, DESIGNED FOR RESISTANCE TO EARTHQUAKES.

bars are used instead of numerous smaller bars.

The precision with which the pan blocks are manufactured provides greater accuracy in constructing the slabs. The height of the pan blocks controls the thickness of the slab. A slab of uniform thickness is thus assured. And, since the pan blocks are of uniform size, if the spacing between two blocks is slightly narrower than the average, the spacing in the next set of blocks will be wider. Calculations have shown that, within certain limits, the stability of the slab therefore does not suffer.

Greater Strength

The structural conformation of the reticular cellular slab is such that it gives the entire frame of the building good characteristics of resistance to unusual strains such as wind or earthquakes. Under these conditions there is a strong condensation of stresses at the point where the columns and the slabs meet. With pan blocks, the width of the beams can be increased to carry the stresses at these points.

The reticular cellular slab also has the ability to resist heavily concentrated loads since they are quickly distributed over a large area. This permits the placing of dividing walls at practically any location. Also, the slab is essentially continuous. The discontinuity characteristic of metallic structures or those with prefabricated structural elements does not exist.

Other advantages of this system include excellent sound absorption and ease of finishing ceilings.

The reticular cellular slabs can be considered as an extension and improvement of the conventional flat slabs. Hence their calculations can be carried out in the same way. The calculations used by Cuellar assume that each panel is composed of two perpendicular series of beams and that the two beams show equal deflection in each intersection.

Calculations

There are limitations for the reticular cellular slab with respect to the ratio of distances between columns and edge conditions. Also, since the width of the

SLAB READY FOR POURING. NOTE HOW THE SMALL BLOCKS HAVE BEEN USED TO FORM WIDER BEAMS.

poured concrete beams is varied in different locations so as to achieve maximum economy of materials, it is necessary to know the precise values of bending moment and shear in every point where these variations take place. The lack of knowledge of these values in internal points of the slab were the probable cause of failure in a slab constructed by a system similar to reticular cellular, described in *Architectural Forum,* March 1952, and *Engineering News Record,* May 1952.

Graphs

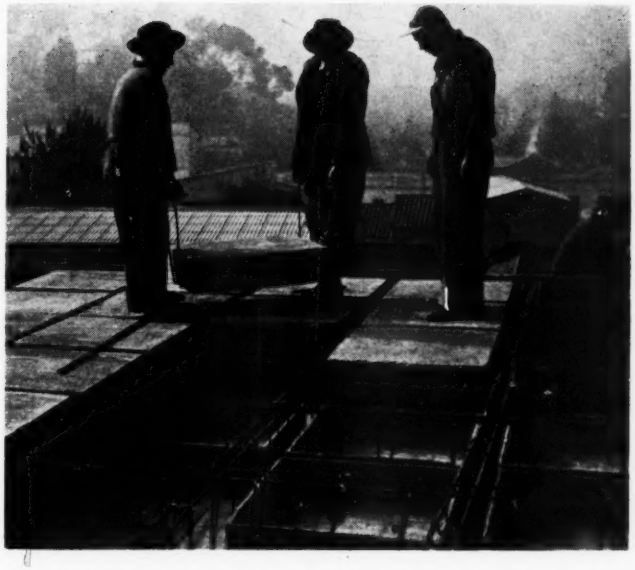
Cuellar has plotted curves of the bending moment and shear stresses for all of the characteristic sections of slabs for such conditions as different ratios of distances between columns, varying ratios of distance between two adjoining beams to clear span, and different edge conditions. Separate curves have been made up for slabs under practically every condition encountered in practice.

Cuellar, Serrano, Gomez & Cia, Ltda. have been using the reticular cellular slab method since 1948. During these six years, this firm and their associates have constructed about 6 million square feet of floor area. The system was patented in Colombia in 1948, and has since been registered in several Latin American countries. Patent studies are now underway in the United States.

Projects

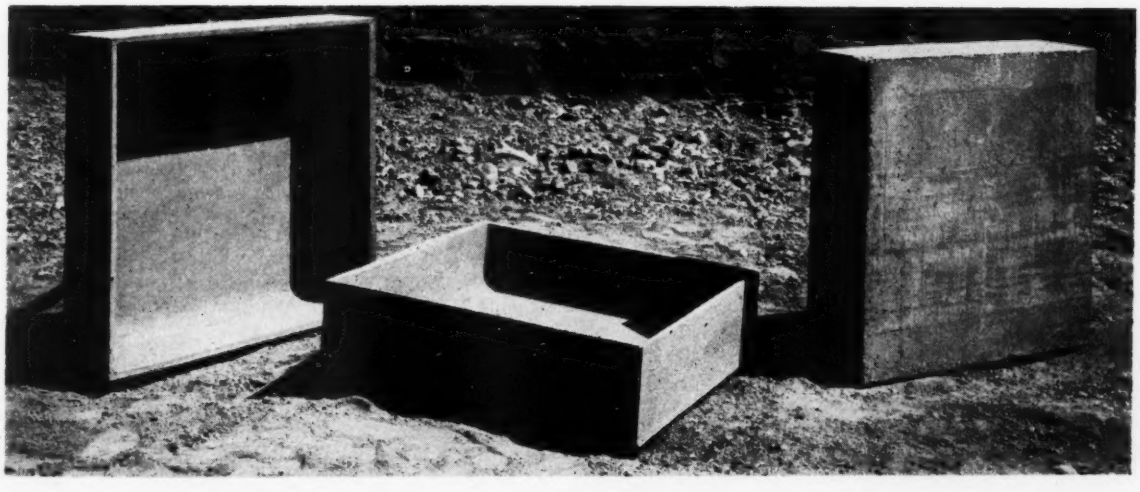
Among the larger buildings for which the Cuellar method has been used is the 9-story (including basement) Bogota branch building of the National City Bank. The plans and specification for this building, which included resistance to earthquakes, were revised by the bank's New York architect and were approved by the underwriters.

Independent tests made by the engineers for the building, Esquerra, Saenz, Urdaneta, Suarez, Ltda., of Bogota, showed that a 16 x 16 in. area of a 36 x 36 in. pan block supported a load of 11,000 pounds without failure. They also showed that the finished ground floor, over a basement, could be used as unloading area for heavy trucks and mixers weighing up to 9 tons.



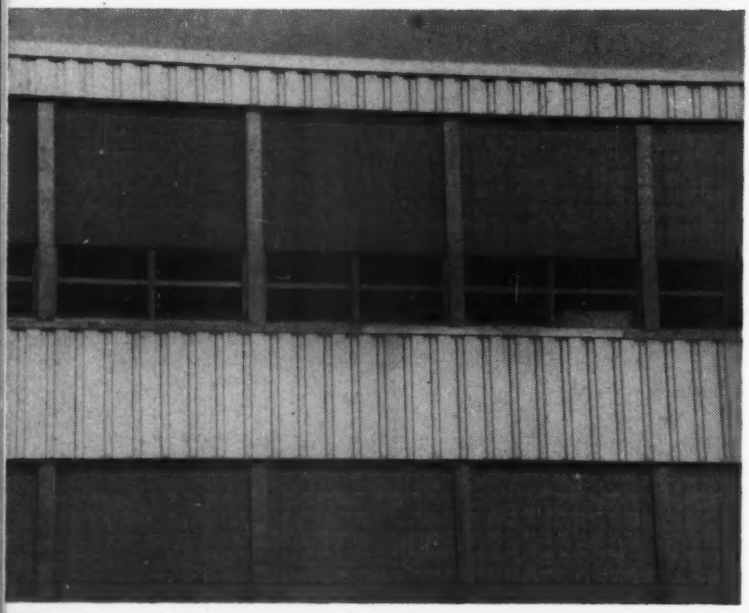
PLACING UPPER HALVES OF PAN BLOCKS. LOWER HALVES AND REINFORCING STEEL ARE IN PLACE.

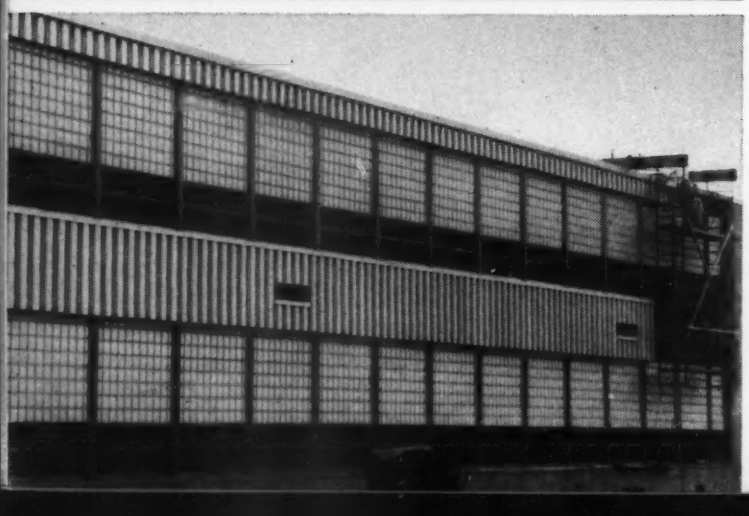
An average of four days was required for the rough work on each floor of the National Bank building. On another building, The Tequendama Hotel, Cuellar required an average of six days for the rough work of each floor of about 7000 sq ft. The structure was finished several months faster than it would have been with either steel or conventional reinforced concrete. On a government financed low-cost housing project, Cuellar finished the skeleton of a 13-story building with 7200 sq ft per floor in sixty days. ▲ ▲

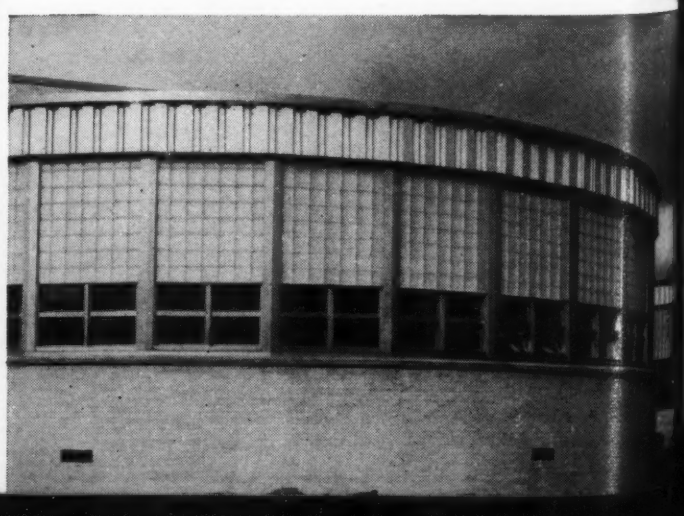


ROUGH SURFACES ON THE PAN BLOCKS INSURE A GOOD BOND WITH THE POURED CONCRETE. BLOCKS ARE MADE WITH SEVERAL HEIGHTS TO PERMIT VARYING SLAB THICKNESS AS REQUIRED.

New EDISON JUNIOR HIGH SCHOOL* takes full advantage of the beauty and utility o







Here is a fine, spacious, new junior high school building that sets a precedent in design and construction. For the architect has made extensive use of one of today's most beautiful and most functional building materials—Stainless Steel.

On the exterior of Edison Junior High School, insulated panels of Stainless Steel form the spandrels and the head panels. The spandrels are of 20 gage Stainless Steel, one foot wide and four feet high with six-inch face square corrugation. The head panels are one foot high. Panels are insulated with one and one-half inches of Fiberglas and attached to the structural framework with clips.

The combination of Stainless with masonry and glass block makes an extremely attractive building. But the benefit of Stainless panel construction doesn't stop there. Construction with the panels was fast and went forward in all types of weather. More complete utilization of floor space was possible through this curtain wall type construction. Maintenance on the Stainless Steel will be negligible and life will be long.

These panels are extremely efficient from a heating standpoint. They have a low rate of thermal transmission (or "U" factor).

Stainless Steel also was used in this school for sills, mullions, windows, door canopies and trim, blackboard and tackboard frames, doors and door frames, column covers and other items of interior trim.

If you have a new school in the planning stage, now is the time to think about Stainless Steel and its many benefits. And think in terms of USS Stainless Steel. For more information on Stainless Steel panel construction, mail the coupon at right. If you like, we will be pleased to have one of our representatives call.

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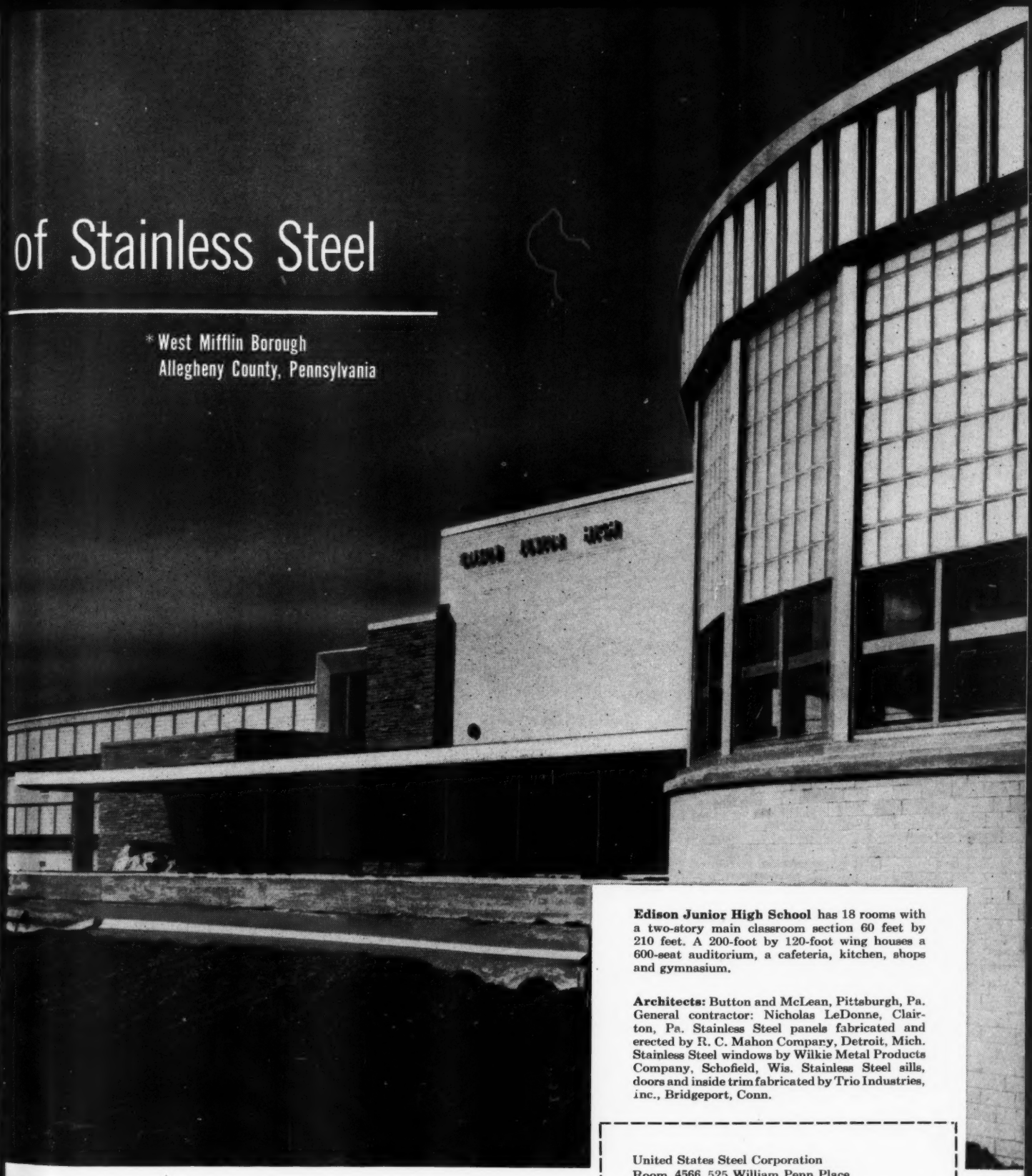

Edison Junior High School has 18 rooms with a two-story main classroom section 60 feet by 210 feet. A 200-foot by 120-foot wing houses a 600-seat auditorium, a cafeteria, kitchen, shops and gymnasium.

Architects: Button and McLean, Pittsburgh, Pa. General contractor: Nicholas LeDonne, Clairton, Pa. Stainless Steel panels fabricated and erected by R. C. Mahon Company, Detroit, Mich. Stainless Steel windows by Wilkie Metal Products Company, Schofield, Wis. Stainless Steel sills, doors and inside trim fabricated by Trio Industries, Inc., Bridgeport, Conn.

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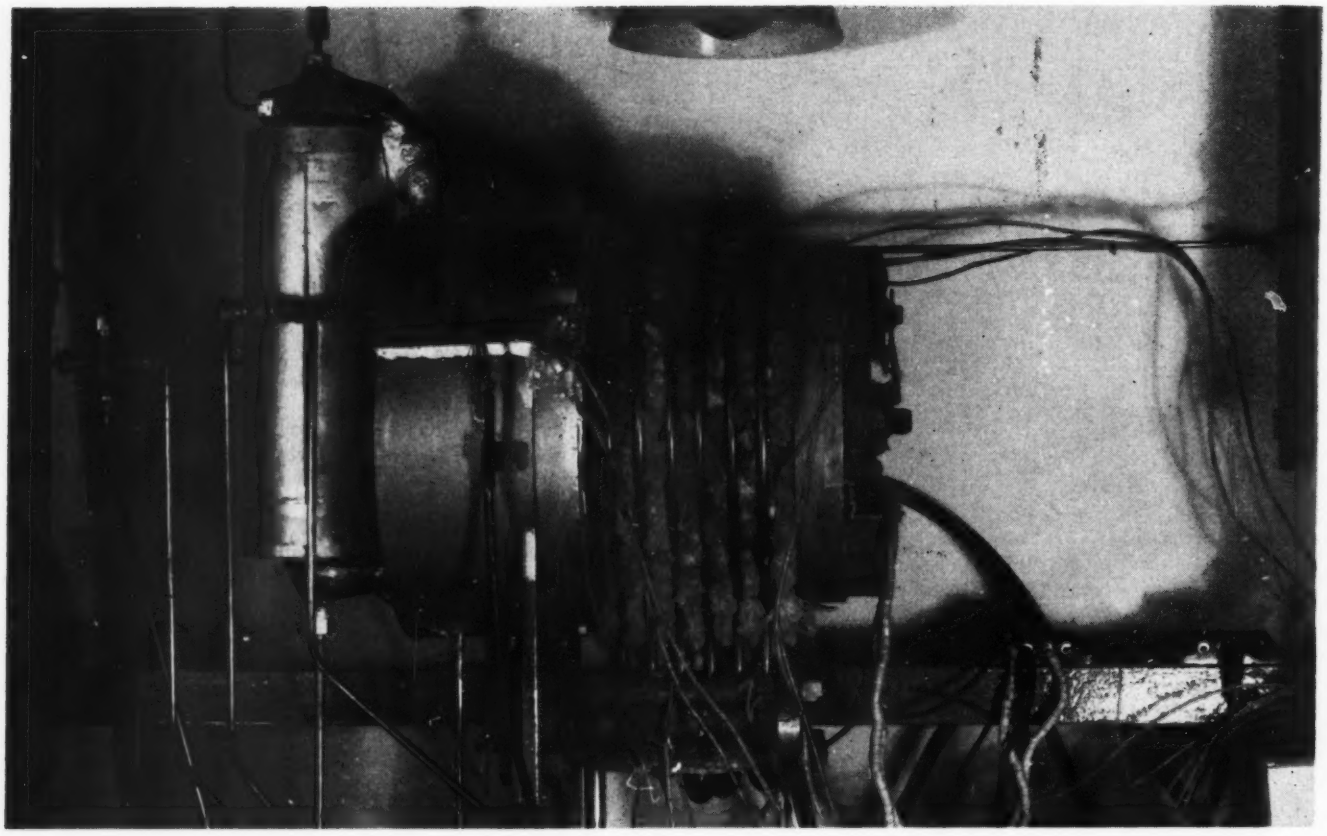

MADE UP OF SIX FUEL CELLS, THIS UNIT HAS SUCCESSFULLY POWERED SMALL ELECTRIC MOTORS AND LAMPS.

The Hydrogen-Oxygen Fuel Cell

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IN THE SEARCH for more efficient means of generating power, we are returning to one of the earliest methods known—electrochemical generation of electricity using a fuel cell. Having an electrochemical efficiency of over 50 percent, the fuel cell may someday become an important power source in industry and transportation.

The principles of electrochemical generation were established long before electricity was generated by conversion of mechanical power from a heat engine. In 1800, Volta developed the primary cell that forms the basis of the modern dry battery. The major deterrent to the early development of electrochemical methods of producing electricity was the high cost of the only suitable materials known at that time. In the 1880's, Mond and Langer built a fuel cell with a useful efficiency of 50 percent, but platinum was the only material suitable for the electrodes.

Meanwhile, the steam engine became the major source of industrial power. At that time the inherent inefficiency of the heat engine was not important because coal was in abundant supply.

In spite of the universal adoption of other systems, interest in the fuel cell as an efficient method of generating power has never lapsed. Over 100 fuel cells have been designed in the last 50 years, but most have remained laboratory curiosities unsuitable for commercial development.

In a fuel cell, electrochemical combustion converts the chemical energy of the fuel into electricity,

together with a certain amount of heat. In electrochemical combustion, either the fuel or the oxidant (or both) is converted from molecular (uncharged) to ionic (charged) forms at the electrodes.

The essential part of the electrochemical reaction is an electrolyte, which acts as a barrier to the molecular forms of fuel and oxidant. If they came into contact, they would react chemically to produce heat. With the electrolyte acting to prevent chemical reaction, the ionization of the elements at the electrodes produces a supply of electrons which pass through an external circuit, such as a motor.

Basic Types

There are two basic types of fuel cells—the direct and the indirect. The direct fuel cell utilizes the reaction between a primary fuel, such as carbon, with oxygen. Neither carbon nor oxygen ionize readily at normal temperatures, however, and the high temperatures required for their operation create several complicated design problems.

The greatest progress has been recorded in the development of the indirect cell, and it is this type that soon may be practicable for commercial development. Perhaps the most promising is a hydrogen-oxygen fuel cell developed in England by F. T. Bacon*. Using hydrogen as a fuel, it is the simplest fuel cell yet reported, and seems the most likely to be capable of commercial development. Its major advantage, according to Bacon, is the possibility that it can be used commercially as a storage battery before undertaking larger units.

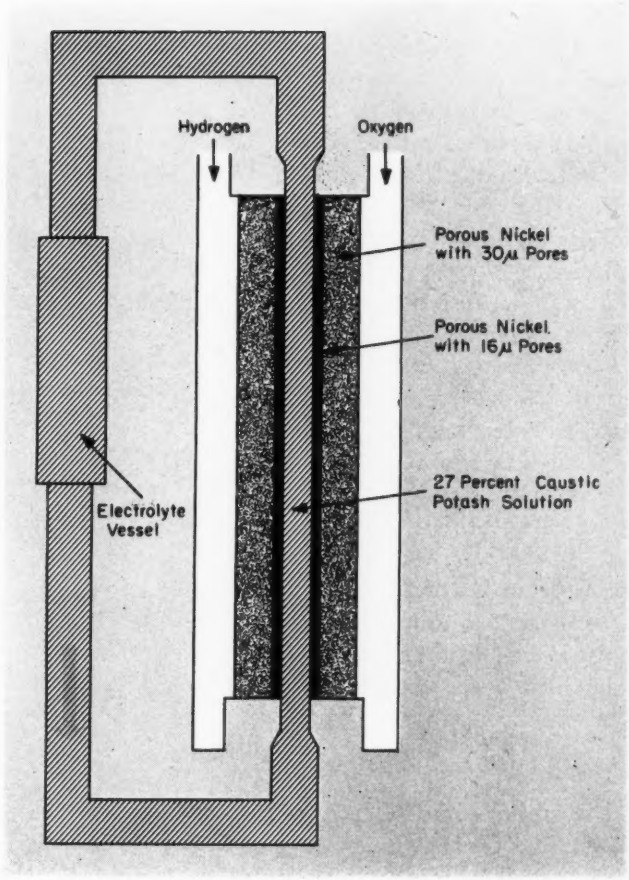


DIAGRAM SHOWS ELECTRODES SATURATED IN HYDROGEN AND OXYGEN AND SEPARATED BY ELECTROLYTE.

A hydrogen-oxygen fuel cell has been operated for a continuous period of 800 hours, of which nearly 300 hours were on load. The efficiency, based on the free energy of the reaction, was 65 percent.

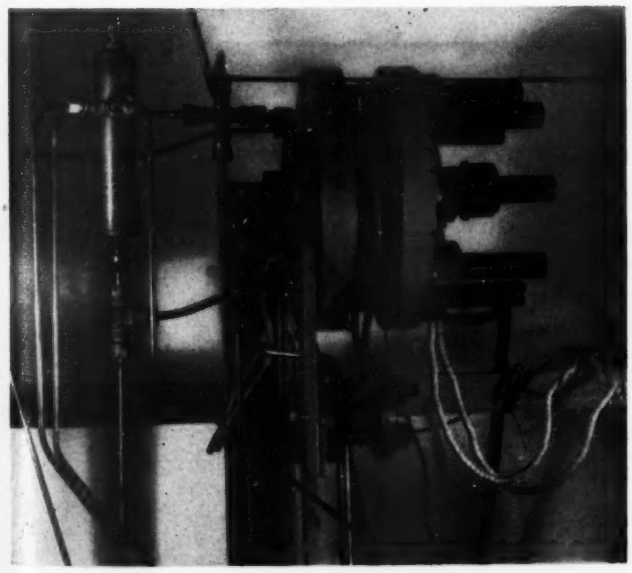
An even longer operating period is now being planned. When completed, it is felt that this cell will be ready to emerge from the laboratory. The greatest obstacle encountered with other fuel cells—short working life—will have been overcome.

The operating principle of the hydrogen-oxygen cell is simply a reversal of electrolysis of water, the electrical energy being generated during the oxidation of hydrogen to water. Although many forms of fuel are available, hydrogen is particularly suitable. The electrodes are kept saturated, one with hydrogen and the other with oxygen, and they behave as gas electrodes. The gas is consumed while the metal of the electrodes remains unchanged.

A Chemical Engineering Problem

Bacon has been associated with the development of the hydrogen-oxygen fuel cell since 1932. At the outset of his investigations, he made a number of

* Working with Mr. Bacon are Professor T. R. C. Fox of the Department of Chemical Engineering, Cambridge University, Dr. J. N. Agar of the Department of Physical Chemistry, Cambridge University, Dr. R. G. H. Watson, Dr. J. E. Bowers, and T. M. Fry. The work has been financed by the Electrical Research Association since 1946, and has been greatly accelerated by additional aid received from the British Ministry of Fuel and Power since 1951.



THE PRESENT LABORATORY CELL. THIS UNIT HAS BEEN OPERATED CONTINUOUSLY FOR 800 HOURS.

fundamental decisions to which he has adhered throughout the development of the cell. He chose an alkaline aqueous electrolyte in preference to sulfuric acid because of the corrosive properties of the acid at elevated temperatures. The electrodes were to be made of nickel or nickel-plated steel, or possibly silver or cobalt, because of the low overvoltages shown by these metals in an alkaline solution.

It was decided that a temperature of 420 F would give the best results with nickel electrodes and also would reduce the possibility of an explosion. Pressures above atmospheric are necessary with an aqueous electrolyte, and 600 psi was selected. This pressure makes it practical to use the standard piping schedules used in power stations. It also was decided not to use any moving parts, such as an electrolyte pump, and to aim for an output of 100 amp per sq ft at 0.8 volt.

The project thus became a problem of chemical engineering, rather than a problem in pure chemistry. The decision to apply engineering principles to the cell's construction has been amply rewarded.

Construction of the Fuel Cell

A number of fuel cells have been constructed since 1932. The present cell consists of two parts bolted together. It is circular, with an internal diameter of 5 inches, and is constructed principally of nickel-plated steel. In the laboratory unit, electric heaters hold the temperature inside the cell constant, but a cell of practical size would provide its own heat from the internal losses. The problem with higher powers may be to dispose of surplus heat.

With the exception of the electrolyte circulation, all the pipework runs almost cold. A small electrolyte vessel maintains the concentration of the 27 percent caustic potash solution when running on load. The water formed when the cell is running over long periods is automatically removed from time to time.

The best performance of the present Bacon cell has been recorded at 490 F and 800 psi. The output ranges from a current density of 151 amp per sq ft at 0.9 volt to 1000 amp per sq ft at 0.6 volt. Voltage efficiency varies from 77 percent at 0.9 volt to 51 percent at 0.6 volt.

The most recent problem has been the gradual oxidation of the oxygen electrode. Progress has been made with this problem and Bacon is confident that a satisfactory solution will be found.

This year, a battery of six cells in series was demonstrated to the public. No difficulties were encountered in constructing the battery, and no special problems are being anticipated in building up a larger number of cells. Some automatic control devices have yet to be perfected.

With the major problems overcome, Bacon is confident of the practical future of the hydrogen-oxygen fuel cell since it provides a greater fuel efficiency than any type of heat engine. It must be realized, however, that the present cell is suitable only for pure hydrogen — a fuel not used in heat engines because of its high cost.

Advantages

Using the total heat of the reaction as a basis, the maximum possible efficiency of the hydrogen-oxygen cell will be about 67.5 percent at 1 volt and 54 percent at 0.8 volt, without taking surplus heat into account. In many applications, the surplus heat can be put to good use.

The fuel cell also has the ability to take large overloads at reduced efficiency, and the low-voltage direct-current produced makes it highly suitable for traction purposes. Since there are virtually no moving parts, its operation is noiseless and vibrationless. The fuel can be derived from coal and, when using pure hydrogen, the exhaust is water.

Since electrical energy is stored in the form of hydrogen and oxygen, the fuel cell itself does not increase in size with the amount of energy stored. The charging process for a fuel cell consists merely of refilling the storage tanks. It is believed that for capacities above 1 to 2 kw, the cell plus its storage tanks would be lighter and more compact than storage batteries storing the same amount of energy.

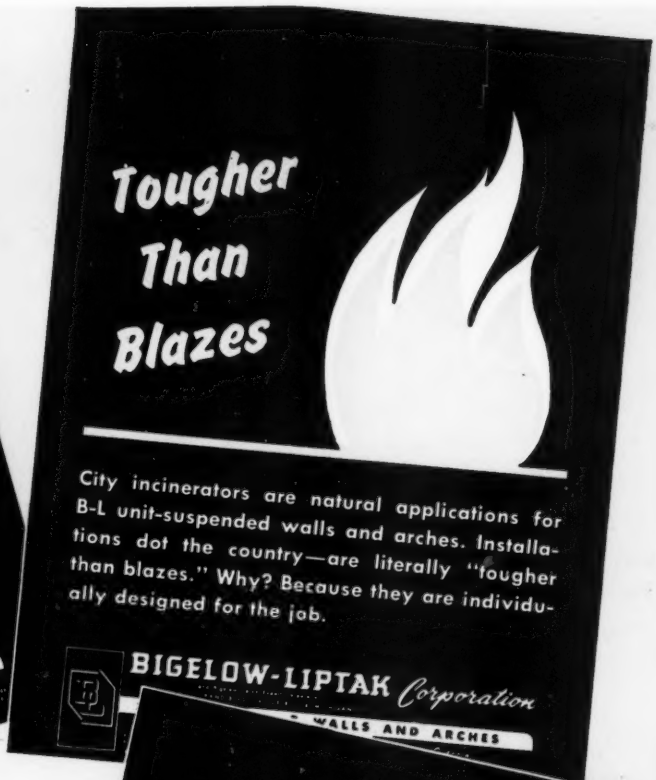
Commercial Applications

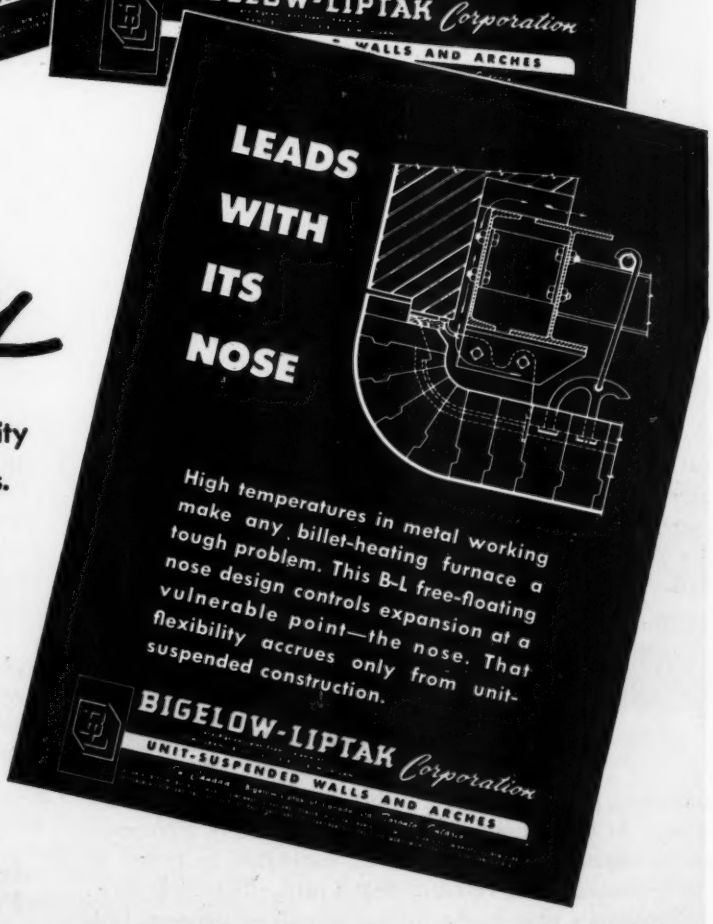
It is likely that the Bacon cell will be used first as a storage battery. This small-scale application will make it possible to gain valuable practical experience before confronting the vast problems associated with large-scale production of power. Also, it may be possible to use impure industrial hydrogen as a fuel instead of the pure hydrogen now being used.

An early application of the hydrogen-oxygen cell is likely to be in rail traction, particularly where electric power from conventional storage batteries would be desirable but cannot be used because of excessive weight or cost. Stationary electrolyzer plants, drawing power during the off-peak periods of power generating stations, would generate oxygen and hydrogen for storage in high-pressure storage cylinders. The gas could then be transferred to locomotives and reconverted into direct-current.

In highway vehicles, too, the hydrogen-oxygen fuel cell might be economical for certain short-range purposes. Another possible use for it would be to store wind power or solar power.

Large-scale generation of power is a more distant prospect, involving the use of oxygen from the air and hydrogen produced from coal by ordinary chemical methods. Since producing pure hydrogen in this way is costly, the fuel cell is not likely to displace any existing methods of power generation in the near future unless it is possible to use impure industrial gases as fuel. ▲▲





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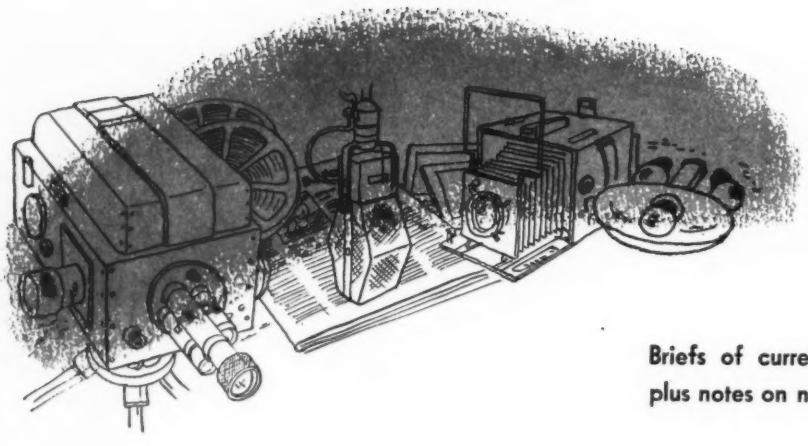


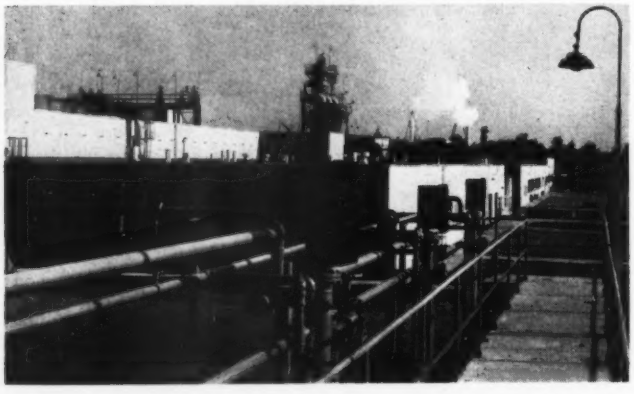
NEWS

Briefs of current interest to the consulting profession plus notes on new equipment in the field of engineering

Modern Plant Layout Provides for Low-Cost Expansion

Planning today's modern industrial plant for possible expansion tomorrow is illustrated in the viscose rayon staple fiber plant, designed and recently completed by the H. K. Ferguson Co., of Cleveland, for Courtaulds (Alabama) Inc., near Mobile, Ala. This multimillion dollar plant will produce 50 million lb of fiber annually.

Engineers laid out the manufacturing building so that it would serve as a sheath or weather protection for the process equipment. The main production equipment, which lends itself to either the "U" or straight line layout, was first arranged in three basic patterns, each with its auxiliary process and service areas. At the same time, the possibilities of two complete expansion plans were investigated in order to help choose most advantageous and efficient layout.



OUTER WALL CAN BE DEMOUNTED AND USED AGAIN.

Provision was made in the auxiliary process layouts to permit these areas to serve also the first expansion and, if possible, the second expansion of the plant. Evaluation of the advantages and disadvantages of each of the basic layouts showed that the straight line layout closely satisfied all requirements.

Auxiliary Processes

Locating auxiliary processes on one side of the main production line permitted filling in the remaining gaps with substations, laboratories, plant service areas, plant offices, and personnel services. This procedure resulted in "squaring" the layout, locating in the main factory block many functions which are often provided for by separate structures at increased cost.

Since one of the major auxiliary processes could be exposed to the weather except for a relatively small control station, walls and roof were dispensed with for this area. This straight line layout resulted in the shortest flow path from the auxiliary process areas to the first plant expansion, and since the material handled is in liquid form and could be pumped, no difficulty of any consequence is expected at the time the expansion is made.

Substations Sized

The substations and personnel service areas also were sized to serve the first expansion requirements so that only a long, relatively narrow building was required to cover the expanded main production line. For expansion only the additional roof is necessary, since the outer wall of the initial plant consists of a five-foot-high, concrete tilt-up surmounted by corrugated asbestos on steel girts bolted to the columns. All of this can be demounted and moved to the new outer wall. The columns are already punched for extending roof beams over the expansion area.

The modern concept of locating manufacturing plants away from densely populated areas with their relatively high land values made it possible to approach this plant layout problem from an entirely new angle.

Indianapolis Sanitation Plans Cleared By Court

Clearing the way for a $19½ million sewer extension and plant modernization program in Indianapolis, the Indiana Supreme Court upheld the contention of the City Sanitation Board that it is not subject to state constitutional limitations on municipal corporations.

The court ruled unanimously that the District was created by the state legislature as a special taxing unit exempt from the bonding limit of two percent of total assessed property valuation imposed by the

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Plans Cleared by Court Decision

—*Starts on page 58*

state constitution on municipal corporations and is governed instead by a 1951 act that established four percent of assessed valuation as the bonding limit for special taxing districts.

The court decision was handed down in a test suit filed by a taxpayer last spring when the board announced plans to issue $8.7 million in bonds for the first projects in its program which would raise the board's bonded indebtedness above two percent.

Work on $4½ million worth of new garbage incinerators will start immediately at the Indianapolis sanitation plant and surveys on a projected $15 million expansion of the city's interceptor sewer network will be started in a few weeks.

In an opinion written by Judge Floyd S. Draper, the Supreme Court said the work to be done "would provide such minimum additions, extensions, and improvements as are presently vitally needed in the Indianapolis area and would enable the city to comply with the requirements of the state's Stream Pollution Control Board."

The Water Pollution Commission of the State of Delaware is also pushing a stream improvement program. Pollution in White Clay Creek, one of the state's major streams, has been considerably reduced by diverting waste water from the National Vulcanized Fibre Co. plant at Newark, Del., to a local interceptor sewer system.

The plant now discharges 75 percent of its waste into the sewer, and when the tie-in is completed the diversion will be almost 100 percent.

Precast Concrete Slabs Form Suspended Ceiling for Garage

The need for a suspended ceiling which would provide a permanent, maintenance-free, non-combustible surface brought about an unusual use for precast concrete slabs during design of Chicago's Grant Park underground garage.

T-irons were bolted to steel hangers suspended from the poured concrete roof on the upper level of the two-story garage. The slabs, 2 x 5 ft and 1⅝ in. thick, rest on these T-irons and are sealed at all joints on the upper side with an asphalt asbestos mastic. The entire under surface of the slabs and the toes of the T-irons are painted white to present the appearance of a flush ceiling. The slab manufacturer cast special slabs with a rectangular cutaway for recessing the flush fluorescent fixtures.

TOES OF T-IRONS WHICH SUPPORT PRECAST CONCRETE SLAB SUSPENDED CEILING EXTEND FROM LEFT TO RIGHT.

The slabs, designed for an ultimate load of 250 lb per sq ft, are reinforced with No. 10 galvanized wire mesh. A total of 13,298 slabs were required for the project.

Between the roof and the ceiling is the plenum chamber for the garage ventilating system which provides 15 complete air changes each hour.

Designers of the project were Ralph H. Burke, Inc. of Chicago and general contractors were John Griffiths and Son Construction Co., Chicago.

Building Trades Union Endorses Modular System

The Bricklayers, Masons and Plasterers International Union officially endorsed the principle of modular coordination at its 22nd biennial convention in Cleveland.

The BM & PIU resolution points out that dimensional system of modular measure was developed by the American Standards Association and is sponsored by the American Institute of Architects, which reports that the method "simplifies the dimensions on working drawings, thus making it easier for masons and other construction men to build from such drawings."

Modular masonry units are already widely available in most sections of the country and have proved to be practical and efficient in many structures.

"Lane Miles" Increase Seen As Solution to Highway Problems

Fifty years ago, before the automobile was an appreciable factor in planning roads, the total rural road mileage in the U. S. was 2,151,000 miles. Today it is only about 50 percent greater, and a good part of this increase can be attributed to development of new territory. The total mileage of the nation's highway system is not expected to increase greatly in the near future, but from figures now available "lane miles" will increase with improvement of existing arteries to form wider freeways and toll roads.

There are now more than 1200 mi of toll roads in operation including 366 mi of the 432 mi New York Thruway and all but a small section of the 165 mi New Jersey Garden State Parkway. Besides the 900 mi of toll projects now under construction, there are 4700 mi of toll roads specifically authorized.

In New York and New Jersey, the metropolitan area highway network, including major bridges and tunnels, has involved an investment during the past 30 years of $1.2 billion for facilities now in operation

Solution to Highway Problems

—*Starts on page 60*

and nearly another billion dollars for projects currently under construction. Roger H. Gilman, Director of Port Development of the Port of New York Authority, expects that by 1960, further construction will cost at least another billion dollars.

It is interesting to note that Under Secretary for Transportation Robert B. Murray recently stated that in his opinion some 12,000 mi of modern highways could be built as wholly self-liquidating toll roads. Two-thirds of the N.Y., N.J., construction was financed on the basis of tolls and charges to be paid by users of the facilities of the agencies concerned such as the Port of New York, Triborough Bridge & Tunnel, New Jersey Turnpike, New Jersey Highway, and New York State Thruway Authorities. The balance of the network was built by regular state highway agencies, primarily out of gasoline and motor vehicle taxes.

Francis L. Brown, partner in Brown & Blauvelt, consulting engineers, serving as moderator of a panel on highway engineering at a conference sponsored by the Institute for Safer Living, commented that cost of the national highway program proposed by President Eisenhower at the conference of state governors might reach $100 billion.

He went on to say, "Investment specialists are of the opinion that such a program can be financed. This may require, in addition to the normal sources of capital such as life insurance companies, other institutional investing and some liberalization of bank credit."

According to *Newsweek* (Nov. 29, p. 75), of the $100 billion, $46 billion would be spent in the normal course of events without any special push from Washington. The additional $54 billion may be financed primarily by public sale of U. S. government-backed bonds.

"Engineering authorities believe that the civil engineering profession can meet the engineering requirements," Brown said. "This will mean the extended use of private engineering firms and greater utilization of professional engineers within government engineering organizations. The competitive situation existing now on large scale construction projects indicates that the construction industry can absorb the shock of the expanding program without disturbance to the industry and that no difficulty should be experienced if future expansion is required to meet the total volume required by the President's program."

Mine Detectors Recover Test Specimens Buried by Storm

Equipped with mine detectors, United States Marines, from Camp Lejeune, N. C., are seeking a new kind of buried treasure at the site of International Nickel Company's sea spray corrosion test lot on the Atlantic Ocean, at Kure Beach, N. C. They are assisting in the search for thousands of valuable specimens torn from test racks by Hurricane Hazel and buried deep in the sand by wind and waves.

Facilities for studies on behavior of materials in sea air at Kure Beach, and in salt water at nearby

AT KURE BEACH, SPECIMENS ARE PUT BACK INTO TEST ON REBUILT RACKS AS THEY ARE RECOVERED.

Harbor Island, have furnished information on how bare and coated metals, woods, plastics, and cordage resist corrosive effects of salt water, salt spray, and sea air.

The destructive effects of the waves at Kure Beach were augmented by the battering action of floating piling and timbers from fishing piers smashed by the storm. The rack supports with their concrete anchors were wrenched out of the ground. The pipe frames were bent and twisted completely out of shape by the wind and waves which piled sand up to a depth of three feet over that portion of the test site area not entirely washed away. Some of the specimens lost had been under test for over 15 yrs.

A larger test lot at Kure Beach, about 800 ft from the ocean and in which nearly 30,000 specimens are exposed to atmospheric attack, was far enough back to escape damage by water.

Larger, More Efficient Boilers Figure in Expansion Plans

In 1880 Thomas Edison signaled the start of central power stations in this country with the construction of the Pearl Street station for New York Edison Co. This station contained six bipolar generators with a capacity of 10,000 lights each. Only 14 ft high, the original Edison boiler required ten times as much fuel to generate a kw of electricity as do modern steam boilers.

In contrast to this, Bacock & Wilcox Co., who supplied the Pearl Street boiler, has recently erected a 12 story high boiler at San Diego Gas & Electric Company's Encina station in Carlsbad. It will operate at a steam pressure of 1450 lb per sq in. and a temperature of 1000 F.

When completed, the new station will house four turbo-generating units with a capacity of 106,000

More Efficient Boilers

—Starts on page 62

kw each. Pioneer Service & Engineering Co. of Chicago, consulting engineers on the project, expect the second unit to be installed in 1956, and the last two units at intervals of two to three years.

Even larger is the 215,000 kw turbo-generator to be added to the Glen Lyn Plant of the Appalachian Electric Power Co., an American Gas and Electric Co. subsidiary.

The unit will be the sixth of a series of 215,000 kw or larger turbo-generators operating in the seven-state AGE system. This one unit will be capable of producing enough power to serve every home in a city of 1,200,000 population. Expected to produce a kw hr from about 7/10 lb of coal, it will operate at a steam pressure of 2000 lb per sq in. and at a temperature of 1050 F.

The latest in a series of modernization steps at Ford Motor Company's Rouge Plant is another boiler installation—one of the largest low-pressure steam units in industrial use. This seven story high Combustion Engineering boiler can produce up to 600,000 lb of steam per hr at 250 psig and 650 F. This is nearly double the hourly steam output of the old boiler.

Design, engineering, procurement, and construction of the modernization project is under contract to the Kuljian Corp.

EJC Holds First General Assembly

Basic theme of the first General Assembly to be held by Engineers Joint Council will be the increase of unity in the engineering profession. The day-long program will take place Jan. 21 at the Hotel Statler, New York City.

Discussions will deal with the engineering manpower shortage, employment conditions as they affect engineers, the national water policy, activities in specialized areas of engineering such as industrial peacetime phases of nuclear development, and finally, future usefulness of EJC to affiliate and associate societies.

New officers will be installed at the evening banquet to be held at the Statler.

Engineers Define "Automation"

In a survey conducted among engineers, technicians, and industrial executives in ten major industry groups, Minneapolis-Honeywell's Industrial Div. found "automation" was the favored word of 82 percent of those questioned when they sought to describe automatically controlled operations.

The consensus was that "automation" embraces automatic handling of materials; control of temperature, pressure and velocity; automatic processing; assembly of parts; measurement of variables; operation of aircraft and missiles; receiving, storing, and shipping functions; computing and data handling; control of household devices; and cost accounting—everything except changing the baby's diapers, it would seem.

Most of the engineers and technicians did not consider "control" to be a part of instrumentation. In their opinion, "automation" is the whole of which instrumentation is but a part.

Concrete Test Chamber Handles Three ASTM Tests Automatically

Equipment to simulate freeze and thaw conditions of concrete samples usually handles up to five cycles a week with different chambers necessary for the three ASTM tests: freezing in air and thawing in water; freezing and thawing in water; and freezing and thawing in brine. Tests with equipment of this kind necessitate much handling of samples and long, drawn out testing periods.

With a new environmental chamber developed by Conrad, Inc., 183 Jefferson Ave., Holland, Michigan, a predetermined test program can be set up covering from one to eight cycles in a 24-hr period. Fifty-five samples can be tested at one time, with the same chamber handling all three tests automatically, without manual adjustment.

STAINLESS STEEL TEST CHAMBER TAKES 55 SAMPLES AT ONE TIME: CAN BE PRE-SET FOR EIGHT CYCLES A DAY.

Fully instrumented, the stainless steel chamber can record both physical and electronic tests. Temperature range is 70 to -20 F.

Synthetic Mica Production To Start in 1955

Mica, best known as an industrial electrical insulator, is also used in many classified defense projects, such as radar, guided missiles, supersonic aircraft, and nuclear developments. Because more than 90 percent of the high grade mica needed in this coun-

try must be imported from India, the Senate's Minerals, Materials, and Fuels Economic Subcommittee has listed it as a Group I Strategic Material.

During World War II Germany set up a pilot plant for production of synthetic mica. After the war this project was studied by U. S. industrial teams. The information gathered formed the basis of a research project by Owens-Corning Fiberglas Corp. and Corning Glass Works. Eventually the U. S. government assigned the project to the Bureau of Mines Electrotechnical Laboratory, at Norris, Tenn. In 1953 Mycalex Corporation of America joined in the research under a cooperative agreement with the Bureau.

The result of this joint effort was development of techniques for commercial production of synthetic mica made of raw materials plentiful in this country — aluminum and magnesium oxide, silica sand, a flouride, and potash feldspar.

The process to be used at the first synthetic mica plant, the Synthetic Mica Corp., at Caldwell, N. J., entails electric melting of these materials in a specially designed furnace. A wholly owned subsidiary of Mycalex, the new company is expected to start production early in 1955 with an annual output of 1000 tons of high grade synthetic mica.

Bureau of Mines research indicates that the man-made material will be superior in some respects to natural mica. It can be made chemically pure, will function effectively in temperatures several hundred degrees higher, and can be hot-pressed and phosphate-bonded into some new "mica ceramics."

These ceramics include an insulation with heat expansion properties similar to steel and made up of ground mica flakes bonded with electrical glass under high heat and pressure, and a hot-pressed machinable ceramic dielectric more easily handled than block talc.

The plant will also operate an experimental furnace to find ways of producing larger crystals of mica and to explore synthesis of new mica compounds. This furnace may also be used for synthesis of other refractory crystals, such as magnesium oxide, with its high infrared transparency.

Synthetic mica now costs more than the natural product but it is believed that cost will decrease as production facilities become larger and more efficient.

AICE Will Hold Annual Meeting January 17 in New York City

Speaker at the Annual Meeting of the American Institute of Consulting Engineers will be G. Brooks Ernest, president of Fenn College, Cleveland, Ohio, and immediate past vice president of the American Society of Civil Engineers. His topic is "Professional Status of the Engineer as Affected by Competitive Bidding." The meeting starts at 12:30 PM at the Engineers' Club, Monday, January 17. ▲▲

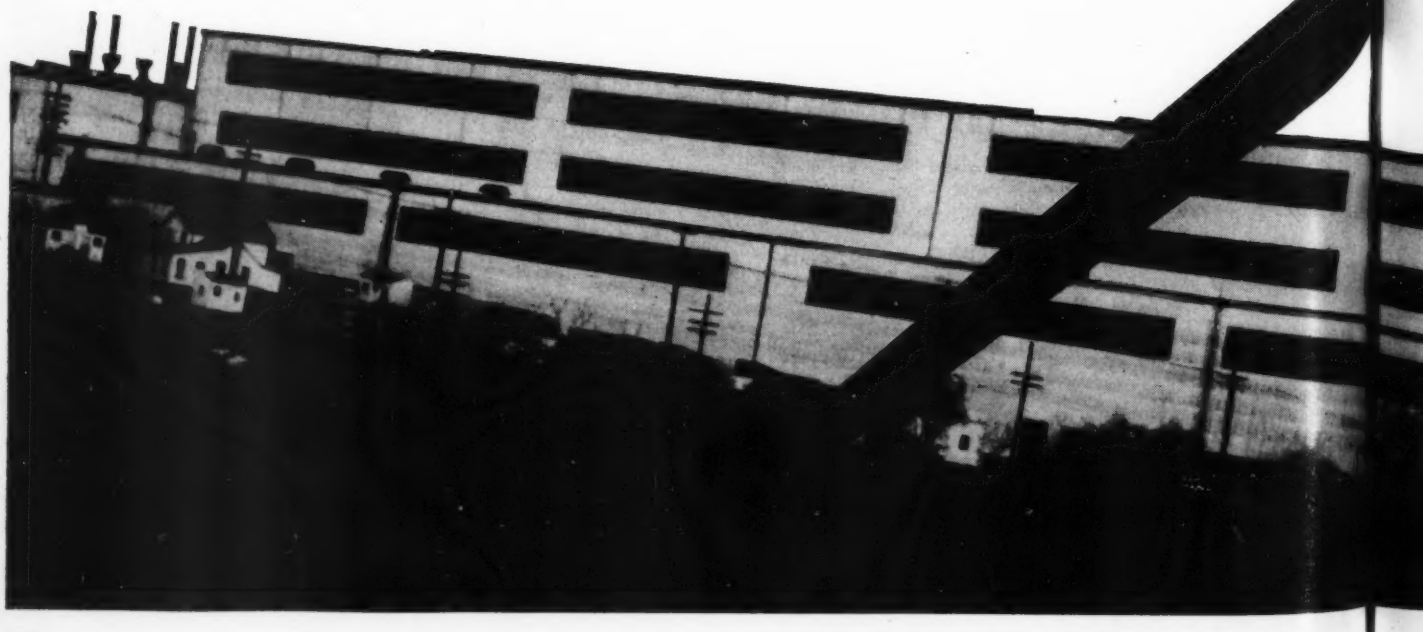
Air Force Plant Saves $33,000 Using Alcoa® Aluminum "Sandwich" Curtain Wall

A new, easy-to-erect aluminum curtain wall saved the U. S. Air Force money through reduced construction time and future maintenance costs on its Heavy Press Plant at Cleveland, Ohio. 157,711 square feet of the new cost-saving siding have been used on the plant, one of the first to use the insulated aluminum curtain wall.

The curtain wall panels were fabricated on the job site from two sheets of Alcoa Corrugated Aluminum Siding, separated by a one-inch thick layer of glass fiber insulation. The "U" value of the wall, 0.155, is twice the insulation value of a 12-inch masonry wall.

Aluminum was selected through competitive bidding against galvanized steel and cement asbestos as the most economical material for the sandwich wall construction. The average bid for the erection of the aluminum curtain wall by six contractors was $1.11 per square foot, compared to an average bid of $1.45 for the galvanized steel and $1.32 for the cement asbestos.

Your local Alcoa sales office will be glad to give you complete details on fabrication and construction with readily available Alcoa Corrugated Aluminum Roofing and Siding. You'll find the number listed under "Aluminum" in your classified directory. Or write for your copy of *Corrugated Roofing and Siding.* ALUMINUM COMPANY OF AMERICA, 1891-M Alcoa Building, Pittsburgh 19, Pennsylvania.



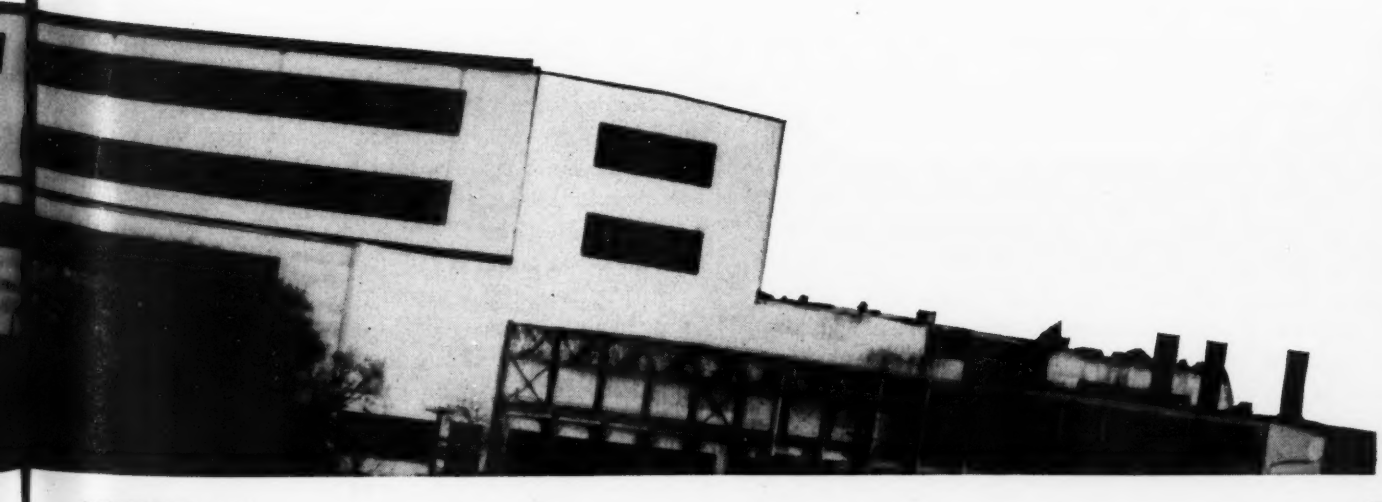
Outer layer of .032-inch thick Alcoa Industrial Siding was secured to structure with self-tapping screws.

Glass fiber insulation was temporarily bonded to inner aluminum sheet with reclaimed rubber adhesive.

Inner layer of .024-inch thick Alcoa Corrugated Aluminum Siding was applied to siding girts with self-tapping screws.

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA



the Range Finder

DR. GERALD J. MATCHETT
Department of Business and Economics
Director, National Center of Dynamic Equipment Policy
Illinois Institute of Technology

. . . how our nation's debt grows

EVERY FREE-ENTERPRISE economy has always been characterized by fluctuations in the general economic level. Whether such fluctuations will continue to occur in the future in the United States is a matter of vigorous debate among economists. A point of widespread agreement, however, is that the role of the government becomes increasingly important in determining the general level of economic activity as the size of government expenditures increases. An objective analysis of government expenditures may be broken into three parts: an analysis of how the government raises money (taxes are only a part of the answer), an analysis of why so much money has to be raised, and an analysis of how expenditures of such magnitude affect the economy as they do.

Consider here how the government raises money. (Later columns will discuss how expenditures have become necessary and how these expenditures affect the level of economic activity.)

The money to meet government expenditures comes primarily from three sources: taxes, interest-bearing loans (borrowing), and the issuance of non-interest-bearing currency. In normal times, the government meets its financial obligations through taxes. In times of national emergency, the government usually resorts also to borrowing. Sometimes, in extreme emergency, it may resort to issuance of currency.

Five times in the course of our history, the United States has engaged in wars of such proportions as to impose a strain on the entire economy. Five times, war necessitated large expenditures of money accompanied by an enormously expanding public debt. In any analysis of fiscal policy, these war periods must be emphasized because it happens that war is the emergency that has produced high government expenditures. In each case, war has resulted in a large national debt. (The government has been in debt since 1837.) Statistical verification proves that any peacetime spending such as that during the depression of the 1930's pales into insignificance and becomes lost in comparison to the expenditures following in the wake of a war.

During the Revolutionary War, the Continental Congress had no taxing power. Its levies on the states resulted in little income. For example, the assessment for New York State was $365,000. Collections were running in the neighborhood of $6,250. (Alexander Hamilton's success in significantly increasing the collections to meet the quota was early evidence of his financial genius, and was so interpreted by his contemporaries.)

The Continental Congress was unsuccessful in the raising of money through tax assessments against the states, and its credit standing was not very good. It was therefore compelled to resort to the third source of income we have mentioned—the issuance of currency. Resulting from its issuance of non-redeemable currency notes, called "Continentals," posterity was bequeathed the phrase, "not worth a Continental."

Slightly more than one-half of the total cost of the War of 1812 was met by borrowing, and slightly less than one-half from taxes. No issue of non-interest-bearing currency was made, which might be taken as an advance in the understanding of public finance. A more accurate explanation, however, is that no such issue would have been accepted by the people because of their experience with the Continentals. (The Continentals had been redeemed ultimately at much below face value.)

During the Civil War, borrowing and the issuance of currency accounted for about three-fourths of the expenditures. About one-fourth came from taxes and the sale of public land—the latter being one asset that is no longer available. By the time of the Civil War, the slogan "not worth a Continental"

apparently had been forgotten.

The nation entered World War I with two new features in its tax structure that enormously aided in collecting revenues. One was the income tax on individuals and corporations. The other was the excess profits tax on corporations. Both have proved to be powerful revenue collectors for the nation, regardless of what may be thought of them otherwise.

Despite these new sources of revenue, only slightly over one-fourth the cost of World War I was met by taxation. A little less than three-fourths of the cost was financed through borrowing. Sources for borrowing money had become much more numerous since Civil War days because capital had accumulated.

Expenditures during World War II were ten times those of World War I. Congress used its taxing power vigorously. It levied new taxes on the incomes of both the rich and the poor, on excess profits of corporations, and on the purchases of furs, cosmetics, liquors, tobacco, and other items. Yet 54 percent of the war expenditure was financed through borrowing. The balance was financed through taxation. During the Korean crisis the picture had not changed appreciably.

This story of enormous national expenditures, and resulting national debts, makes clear the ways in which a government can meet its costs. Two questions remain to be answered. Why have such large expenditures been necessary and what have been their effect on the national economy? The answers to these questions give us a partial insight into one element affecting the level of economic activity in the United States.

Some understanding of these basic questions of government finance is needed by every business man, but particularly by consulting engineers. Their operations are so closely tied in to the general economy that they should study the economic picture if they are to plan for tomorrow. ▲ ▲

MEN IN ENGINEERING

★ Harold W. Sweatt, chairman of the board of Minneapolis-Honeywell Regulator Co., is appointed special consultant to the Foreign Operations Administration to assist with work in Europe.

★ The Austin Co. is establishing a Brazilian engineering and construction company to be known as Companhia Austin — Engenheiros e Constructores, with headquarters in Sao Paulo. Cyril F. Prideaux, who served as project manager for antibiotics plant in Brazil, is appointed president of the new company.

★ Allis-Chalmers Mfg. Co. announces retirement of Henry V. Nye as consulting engineer for switch gear equipment. Nye has been with A-C for 48 years.

★ Brown Boveri Corp. of New York announces appointment to its staff of Doctor Ledo R. Carletti as head of consultation on supercharging of diesel and gas engines.

★ Arthur M. Lawrence is named director of public relations for The Rust Engineering Co.

★ J. G. Detwiler joins the staff of Foster D. Snell, Inc. as a petroleum consultant. He was formerly supervisor of tests and specifications at the Texas Co., Port Arthur, Texas.

★ United Engineering Trustees, Inc. has re-elected James L. Head president. Head is a mining engineer with Anaconda Copper Mining Co. Other officers elected were: W. J. Barrett of New Jersey Bell Telephone Co. as vice president; and W. F. Thompson, vice president of Westcott & Mapes, Inc., vice president; Waldo G. Bowman of McGraw-Hill Publishing Co., treasurer; Joseph L. Kopf, president of Jabez Burns & Sons, Inc., assistant treasurer; and John H. R. Arms, secretary.

★ Robert P. McKenrick is promoted to vice president-general manager of Blaw-Knox Company's newly-formed Construction Equipment Div. at Mattoon, Ill.

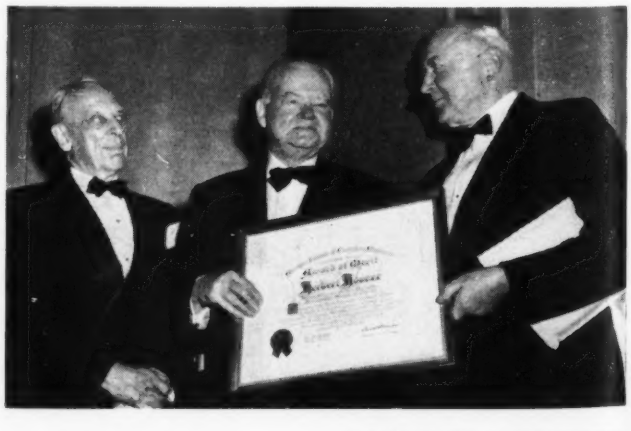
★ Arthur S. Locke, formerly consultant in the radar division of the National Research Laboratory, is appointed associate director of the West Orange, N. J. Laboratory of Vitro Corporation of America.

★ William J. Wenzel and Colonel Hubert S. Miller (Corps of Engineers, rtd.) have formed the firm of Wenzel & Miller—Engineers. Offices are at 41 Meadow Lark Drive, Great Falls, Montana.

★ Sundberg-Ferar, industrial designers, announce the addition to their staff of Ernest W. Batterson as a development engineer. He will

AICE HONORS HOOVER, SLOAN

Alfred P. Sloan, Jr., (L.), General Motors Corp., looks on as former President Herbert Hoover gets AICE Award of Merit from Scott Turner, (R.) president of AICE. Sloan was awarded the Hoover gold medal for distinguished public service.



act as coordinator for engineering aspects of various design projects and will head research activities in new materials and processes.

★ The Associated General Contractors of America, Inc. have nominated George C. Koss for president and Frank J. Rooney for vice president. Koss is president of the Koss Construction Co. of Des Moines, Iowa, and Rooney is a building contractor in Miami, Fla.

★ Emile P. Leclerq has joined the firm of Seelye, Stevenson, Value & Knecht, Consulting Engineers as a specialist in water treatment, sewage disposal, and industrial wastes.

★ William T. Nichols joins the staff of Arthur D. Little, Inc. as a senior staff member.

WESTCOTT HARTFORD

★ During the President's Luncheon at the Annaul Meeting of the American Society of Mechanical Engineers, Harry Westcott, president of Westcott & Mapes, presented Ernest Hartford, retiring Deputy Secretary of ASME, with a book of letters of tribute written by prominent engineers in appreciation of Hartford's 43 years of service to the engineering profession.

★ The American Society of Civil Engineers announces the forthcoming retirement of William N. Carey as executive secretary effective May 1, 1955. He will be succeeded by William H. Wisely, at present executive secretary of the Federation of Sewage and Industrial Wastes Associations and editor of its publication, *Sewage and Industrial Wastes.*

★ Byron Jackson Co. announces appointment of Ross Barrett as director of advertising and public relations, in line with the company's expansion in four fields: electronics, the foreign market, in automatic production, and in atomic power. The company had formerly concentrated on manufacture of pumps, oil drilling and production tools, industrial rubber products, and electronic instruments. ▲▲

GENIUS AT WORK — 1890

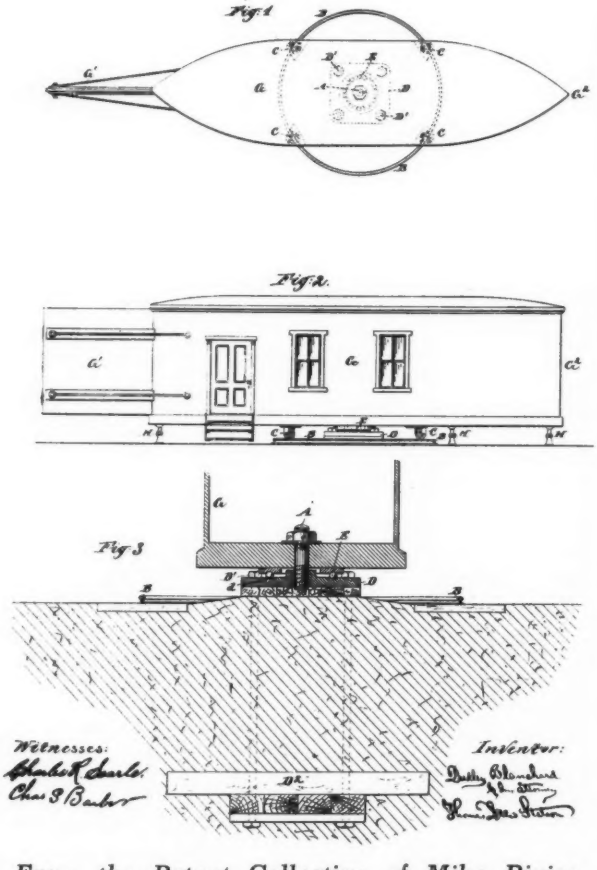
THIS BROOKLYN inventor, Dudley Blanchard, states that the object of his invention is "to provide more perfectly than heretofore against injury from tornadoes or other violent storms."

According to the Letters Patent, G is a light, strongly braced building resting on the balls E and wheels C. It is steadied by the pivot A. A large and strong wing or vane G′ is fixed at one end of the building, which is, itself, wedge shaped at each end. H H are a set of jack-screws capable of being adjusted under the building to hold it firmly under ordinary conditions.

But when a wind comes . . . All you have to do is run out and unscrew the jack-screws, and the house is ready to turn with the wind. If the wind changes (as is to be expected in a tornado) that's all right, the house turns with it, protecting the inhabitants from anything worse than a bad case of dizziness.

The inventor also points out that this design is ideal for hospitals even in pleasant weather, for with no trouble at all, the sick rooms could be kept "to the sunshine during the whole of a long summer day."

Later day designers have obviously missed the boat in not adopting this plan to a revolving ranch house or a circulating Cape Cod cottage.



From the Patent Collection of Mike Rivise

Profitability Calculations Simplified

—Starts on page 44

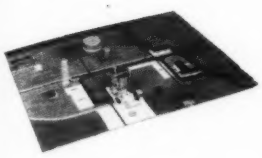
working capital requirements. These items should not be ignored for an actual case study.) The consultant estimates that cost of sales will be 35¢ per carton; administrative and selling expenses are estimated at 5¢ per carton.

The business is considered to be a high risk business and the consultants believe that a high risk operation such as this should pay out in three years. Ajax is a corporation in the tax bracket where the Federal income tax rate is 52 percent of profits. The situation for annual net cash return is exactly as shown on the Projected Profit and Loss Statement of the first example. Income tax and fixed charges can be assumed to be the same as calculated for the first example. Detailed calculations for a recommended sales price using the payout period method of approach are shown in the adjoining columns.

With the sale of 1,000,000 cartons of flypaper at a net revenue of $1,119,500, the calculated sales price required to meet a 3-year payout time would have to be $1.12 per carton. This is one method of deriving a sales price when competitive prices do not exist, or when other means of establishing a sales price are not available. Notice that income taxes for this example account for 30 percent of the sales dollar.

Whether profitability projections are made by means of a graph or by means of a tabulation, the analysis so made has true meaning. In dollars and cents, it shows the money that will be available to write off (payout) the original investment. The corollary is, knowing the required payout time, a suggested sales price.

So the consulting engineer can answer his client's question: "What will be the return on our investment?" It will be the cash generated each year to pay out the original investment after all allowances are made for income taxes, cost of sales, fixed charges, depreciation and administrative and selling expenses. It can be shown in dollars and cents as the annual net cash return; this return can be effectively correlated with the investment by calculating the payout time. ▲▲



Models for Design

—Starts on page 32

ing at a location convenient to the three clients. The pieces were assembled on boards marked out in one- and four-foot squares. After much moving of components, a design acceptable to all was developed and photographed. Fig. 5 is one of the photographs. From the photographs, the detail drawings were started. Considering that all the pieces of this crude model cost less than $600, we concluded that the design was crystallized quite inexpensively.

As a second step, the model shown in Fig. 6 was prepared from unchecked drawings. This model and the crude predecessor were both scaled ¼-in.-to-the-foot. Photographs of the second model were distributed to all the clients to be sure that the agreement on design was still unanimous.

Since much field work was to be performed from each drawing, any error not caught in checking would have to be corrected four times in the field. Thus, though there were no congested areas, a ¾-in.-to-the-foot model of the area containing most of the piping was warranted. This is shown in Fig. 7.

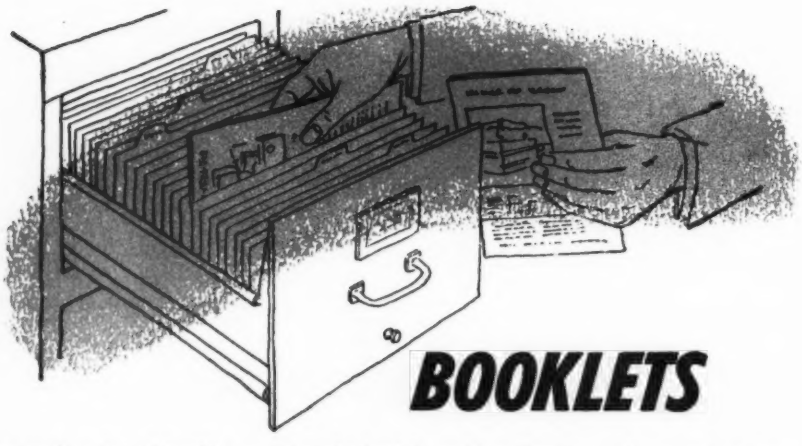
The models considered here have all been design tools only. After the job is completed, they have no more use than a preliminary study sketch would have. The models are fairly crude, with only the pertinent and necessary detail shown. This crudeness is a necessity, both to keep the cost down and to finish the model quickly enough to be of design value on the job.

Costs

There is a tremendous variation in model costs. We have used one costing $200 and one costing $35,000—both being extremes. In general, slightly less than $1000 would cover the cost of most small scale models similar to that in Fig. 1. The general vicinity of $10,000 would cover a model at ¼-in.-to-the-foot for a plant with all piping and valves shown, down to about 6-in. sizes. It takes very few field changes to make up the cost of an average model.

For most models, cost of material is not important —probably averaging not over 10 percent of model cost. The major component of model cost is labor. This can be higher on a small scale model than on a larger one. The engineer and model maker should discuss fully in advance the scope, scale, extent of detail of components, and similar items.

The use of a model must be approached with study and thought to see if practical objectives exist, if the model contributes what is necessary faster and cheaper than any other method, and if the model is of good scope and scale for the purpose. With a careful approach, the model can be a very fine, cost-saving design tool with more uses than first imagined.



BOOKLETS

Personal copies of booklets can be obtained by writing directly to the manufacturers

SCHOOLS find Hev-E-Oil burners the answer to efficient, economical heating according to four-page bulletin AD-139. Fuel flexibility, economy, and safety in typical installations is pointed out. *Cleaver-Brooks Co., Dept. CE, 326 E. Keefe Ave., Milwaukee 12, Wis.*

TECHNICAL REPRINT T-126 presents a comprehensive discussion of the new Packaged Water Treatment Plant. Cut-away view shows details of equipment. Typical layout drawing is included. Heart of the plant, the Graver Reactivator is shown in a cross-sectional view with drawings of flow and sludge movement. *Graver Water Conditioning Co., Dept. CE, 216 West 14th St., N. Y. 11, N. Y.*

ADVANCED DESIGN of the Air-Grip Clutch and an explanation of how this design provides ease of operation and instant response is explained in four-page bulletin A-634. Information on air control and release valves includes a table of clutch sizes, dimensions, bore sizes, and weights. Other types of clutches are described briefly. *Dodge Mfg. Corp., Dept. CE, Mishawaka, Ind.*

"ALUMINUM BRIDGE RAILINGS," 52-pages, shows the designs which use aluminum most efficiently. Chapter on all-aluminum lighting standards presents ways of intergrating lighting methods and equipment with bridge railings. *Reynolds Metals Co., Dept. CE, Desk PR, 2500 S. 3rd St., Louisville 1, Ky.*

"GOOD LIGHTING IS GOOD BUSINESS," 19-page bulletin F-687 covers the economics and mechanics of good office lighting in non-technical terms. Combination sound reduction —illumination systems are shown. *Sylvania Electric Products Inc., Dept. CE, 1740 Broadway, N. Y. 19.*

ENGINEERS AND DESIGNERS concerned with problems involving stainless piping will find valuable data in six-page bulletin TB-356. It outlines methods of bending and joining stainless pipe and discusses the problems of light wall versus heavy wall pipe with tables of dimensions and weights of various stainless pipe size schedules. *The Babcock & Wilcox Co.. Tubular Products Division, Dept. CE, Beaver Falls, Pa.*

SIDE DUMP STOKERS with Moving Grates, recommended for high capacities and good performance with coals from the Pittsburgh-Ohio Seam and other similar coals are described in six-page folder. Labeled diagrams and illustrations show how the hydraulic drive and steam drive units operate and how they are installed. *Riley Stoker Corp., Dept. CE, Worcester, Mass.*

"COLLOIDAIR SYSTEMS for Recovery of Suspended Materials . . . ," technical bulletin CS2, describes a system for recovering suspended solids from process liquids. and for waste water treatment. Factual data is given on efficiency of the process, typical installations, operating principles, and analysis of types of industries that can profit by using this system. *Bulkley Dunton Processes, Inc., William Krapf, Mgr., Dept. CE, 295 Madison Ave., N. Y. 17.*

LOW-TEMPERATURE PIPING insulation known as Vapo-Wall, made of Dow Styrofoam, can do a better insulating job for less cost than conventional installation according to four-page phamphlet. Specification sheets and ordering data for standard and special applications are included. *MMM Inc., Dept. CE, 7120 Avenue C., Houston, Texas.*

BEFORE SPECIFYING BOILERS for modern school buildings or for modernizing existing buildings, you will

want to read over the check list of what to look for in a boiler for these applications as presented in four-page folder 512. Installation photographs show the fully automatic packaged steam generators offered by this company. *Johnston Brothers, Inc., Dept. CE, Ferrysburg, Mich.*

"RUBBER AND GASKET ENGINEERING HANDBOOK," 82-pages, is a comprehensive technical discussion of every phase of the subject including standards, specifications, testing, and special uses. *Minnesota Rubber and Gasket Co., Dept. CE-KP, 3630 Wooddale Ave., Minneapolis 16.*

CENTRIFUGAL PUMPS — Four-page bulletin 519-A gives complete information on the Type SB horizontally split case, double balanced suction pumps including dimensional drawings and a cross section explaining construction. Graphs show performance of the 1750 rpm, the 1150 rpm, and the 3450 rpm units. *The Weinman Pump Mfg. Co., Dept. CE, 290 Spruce St., Columbus 8, Ohio.*

"SKYTROL GLASS BLOCKS FOR TOP-LIGHTING YOUR BUILDINGS," eight-page bulletin GB 105, has been prepared as a reference manual for architects and engineers. It gives information on physical performance, light transmission, insulation values, detailed drawings, and complete specifications. *Pittsburgh Corning Corp., Dept. CE, 1 Gateway Center, Pittsburgh 22, Pa.*

"PRESSURE OPERATED CARBON DIOXIDE FIRE EXTINGUISHING SYSTEM," 11-page bulletin, will tell you by text and drawings all you want to know about the automatic electric type system, how it works, and where it works. *Walter Kidde & Co., Inc., Dept. CE, 200 Madison Ave., N. Y. 16, N. Y.*

BALL-BEARING SWIVEL JOINTS — Dimensional and operating data on the complete line of ball-bearing swivel joints and other products made by this company are included in 32-page catalog G-4. Typical industrial applications are illustrated showing how each product meets specific needs. *Chiksan Co., Dept. CE, Brea, Calif.*

REDUCING HANDLING COSTS — Sixteen-page bulletin "How to Pull Dollars Out of Thin Air" tells how

BOOKLETS

—*Starts on page 74*

handling costs can be reduced by using the proper pneumatic handling system. This bulletin, G-2, covers the rotary compressor, the clinker cooler, and the new kiln preheater. *Fuller Co., Dept. CE, Catasauqua, Pa.*

"TODAY'S TREND AND TOMORROW'S TURBINES," six-page booklet 03-R8182, gives valuable information on the overall turbine picture. A reprint from the second quarter, 1954, *Allis-Chalmers Electrical Review. Allis-Chalmers Manufacturing Co., Dept. CE, 1140 S. 70th St., Milwaukee 1, Wis.*

"NORTON REFRACTORIES FOR THE CERAMIC INDUSTRY," 28-page-booklet, lists properties and advantages for specific applications, contains engineering tables, and other data used in connection with refractories in this industry. *Norton Co., Dept. CE, Worcester 6, Mass.*

REMOTE READING GAGES — Eight-page catalog 246 covers in detail the three standard types of convex Scale and Flat Truscale Remote Reading Gages, showing how these gages bring liquid level down to where it can be seen easily— protecting valuable equipment and preventing expensive shutdowns. *Jerguson Gage & Valve Co., Dept. CE, 80 Fellsway, Somerville 45, Mass.*

BOILER BAFFLES — More than 30 boiler-setting plans are shown, with an analysis of how each arrangement of tubes is baffled to meet, in each case, the specific boiler design, in 20-page bulletin BW-54. Detailed problems in installation of baffles are also discussed with information on precautions to take. *The Engineer Co., Dept. CE, 75 West St., N. Y. 6, N. Y.*

SHAFT MOUNTED DRIVES for machines which require input speeds between 420 and 10 rpm in the hp range between ½ and 30 are described in bulletin 7101, "Shaft Mounted Drives by Falk." This eight-page bulletin contains all essential information about these modern gear drives. *The Falk Corp., Dept. CE, 3001 W. Canal St., Milwaukee 8, Wis.*

BLOWERS AND EXHAUSTERS — Revised 12-page bulletin M-103 describes blowers and exhausters built for applications requiring air pressure from one to 9 lb per sq in., or vacuum from two to 12 in. mercury. It gives design, types, and advantages, with charts that show capacity ranges. *Air Appliance Div. of U. S. Hoffman Machinery Corp., Dept. CE, 105 Fourth Ave., N. Y. 3.*

SAVINGS THAT MAY ACCRUE from use of straight run or cracked residual fuels with the Type TS-29 stationary and marine diesel engine are pointed out in 11-page bulletin 235. These engines, operating as Dual-fuel units also burn gas. The booklet shows the engines installed in municipal central power stations, public utilities, and in industrial plants in sizes from 4500 to 10,000 hp. *Nordberg Manufacturing Co., Dept. CE, Milwaukee 1, Wis.*

APPLICATIONS OF GAS TURBINES for gas pipeline pumping are shown in 12-page booklet GEA-5962. Flow charts, tables, and a cut-away view add to the value of the booklet. *General Electric Co., Dept. CE, Schenectady 5, N. Y.*

"CLEAN WATER — AND HOW TO GET IT," 34-page booklet GEA-6096, contains facts on water pollution, a four-step course of community action to fight pollution, examples of successful campaigns, and methods of maintaining public support for such programs. *General Electric Co., Dept. CE, Schenectady 5, N. Y.*

"THE KODAGRAPH MICROPRINT READER, MODEL A," describes a device designed to be used in offices and libraries where literature and reference work has been reduced to microprint cards. The reader will take Microcard, Microlex, or any other size up to 8½ x 14 in. The booklet covers operation of the machine and what can be expected of it. *Eastman Kodak Co., Dept. CE, Rochester 4, N. Y.*

THE FACTS you want to know about air conditioning an entire building with individual packaged units are given in 16-page bulletin A-3007. Documented by results from a major multiple room air conditioner installation, the report includes the four major points that must be considered. *Air Conditioning Div., Dept. CE, Philco Corp., Tioga and C Streets, Philadelphia 34, Pa.*

TO AID FIELD ENGINEERS in laying out and planning water and sewage systems, field sketch pads printed on light weight stock in orange ink will be sent free of charge. Special symbols are printed on the sheets to help standardize simple pictorial representations of water treatment and sewage processing elements. *Automatic Control Co., Dept. CE, 995 University Ave., St. Paul 4, Minn.*

"SIMPLIFIED PRACTICE RECOMMENDATION R 207-54, Pipes, Ducts, Fittings for Warm-Air Heating and Air Conditioning," consists of a simplified list of pipes, ducts, and fittings as well as sketches intended as an aid to identification of the items listed. *Superintendent of Documents, Government Printing Office, Washington 25, D. C.: Price 10¢.*

ENGINEERING DATA for standard conveyor belt construction is shown in color on this chart of eight of the most popular ply and material combinations. It shows theoretical and actual ultimate strength, fastener strength, operating strength with fasteners and splice, and troughing index. *Belt Dept. CE, Quaker Rubber Corp., Div. of H. K. Porter Co., Inc., Tacony and Comly Sts., Philadelphia 25, Pa.*

THE PROBLEM OF UNIFORMLY ACCURATE liquid level gauging in tanks of all sizes, containing any liquid at temperatures up to 175 F, is discussed in eight-page bulletin P-591 which offers an electronic tank gage as the solution. A cut-away view shows the unit in operation with one of the various recording instruments available. *Gilbert & Barker Manufacturing Co., Dept. CE, West Springfield, Mass.*

"BEAMS AND GIRDERS FOR WELDED PLATE" is the first of a series of engineering reports to be issued monthly under the general title "Modern Designing with Steel." Papers will include engineering data, design samples, and pictures of finished projects where new techniques were used. *Kaiser Steel Corp., Dept. CE, 1924 Broadway, Oakland, Calif.*

TEMPLATE KITS of 68 tracing templates of De-Sta-Co Toggle Clamps are available free of charge in full, half, or quarter-scale. Drawings include all recent models and refinements on established models. *Detroit Stamping Co., Dept. CE, 321 Midland Ave., Detroit 3, Mich.*

ENGINEERING HELP AND ELECTRIC EQUIPMENT furnished by this company for heavy construction projects such as tunnels and bridges is covered in eight-page bulletin GEA-6196. Case history includes electrical systems of lighting, bridge control, and power systems. *General Electric Co., Dept. CE, Schenectady 5, N. Y.*

SCREENING EQUIPMENT for efficient removal of solids from water, sewage, and industrial waste is described in 28-page bulletin 2587. It gives complete data for both coarse and fine screens and tables to determine the proper size unit for handling various capacities. *Link-Belt Co., Dept. CE 115, 307 N. Michigan Ave., Chicago 1, Ill.* ▲▲

A Matter of Ethics

CONSULTING ENGINEER *will pay $25.00 for each published example of problems of professional ethics sent in by readers.*

Another $10.00 will be paid for the best discussion of the problem published.

See page 24 for discussion of last month's problem.

CONSULTANT A, an expert in ceramic cleansing, was retained by a manufacturing company to investigation methods to reclaim brick by treatment with pressure streams. The development of new products and marketable devices was the agreed-upon aim of the program. He was asked to visit a cooperating plant, which used pressure stream cleansing equipment for other purposes. He made the visit, examined the installation, and was given a model of the machine. He reported that the principle involved had no value for his clients. Then he was asked to prepare a digest of the literature.

About this time personal matters diverted his attention, and he brought into the project another engineer, sub-consultant B. B was given access to all files of company correspondence, memoranda of conferences, and project definitions as well as available literature. He continued preparation of the literature survey, charging only for his time.

In the course of a client interview, however, he offered to disclose, for extra payment and a royalty to be negotiated, certain ideas he had developed about the washing of brick by pressure streams. The company protested that these inventions, if such they were, should be given as part of the consulting service. Sub-consultant B refused. His position was that he had been retained to complete A's literature survey, not to develop a device; that his ideas were neither a part of nor derived from the survey, and that he considered them to be patentable.

The company then requested that all members of the project (which now included three other persons brought in by consultant A) sign retroactive patent contracts, with payment of 10 percent additional patent fee on subsequent work. Sub-consultant B refused to do this.

Sub-consultant B then mailed copies of his ideas and claims to the client with a letter of transmittal stating that this constituted disclosure, and stated that he had previously established his development of the ideas by showing them to disinterested witnesses. Considering this the last disloyal act of a dissatisfied, trouble-making, potentially litigious character, whose professional work in the literature digest (now submitted as his first major contribution to the program) they considered to be of insultingly elementary and uninformative quality, the client company then returned the designs and cancelled the whole contract.

They took the position that B's broad claims might later endanger the whole program; that mutual confidence, loyalty, and trust in professional integrity were essential to the success of the project; and that B's actions had caused suspicion of A and his whole group. The clients further alleged willingness to pay voluntarily at their valuation for individual ideas outside the contract scope, but resisted strongly B's attempt to interpret the scope of his assignment more narrowly than had been the company's understanding with A.

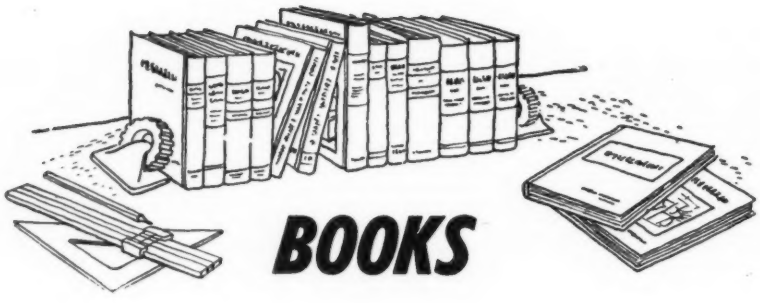
Finally, they urged that the ideas in question were related to the devices primarily sought by the whole investigation and could readily have been suggested by the literature or plant visited and reported by A. The clients believed that other consultants considered themselves retained primarily to furnish novel ideas in the defined field or in any other area of interest to the client; therefore B was only doing what he had been retained and paid to do. B, however, stood fast to his original decision that the ideas were his, that conceptions are the only property of an expert, and that he would not give them up without extra payment beyond his time-bills as a consultant.

Are the tenets of professional engineering ethics being violated or strained at any point? If so, how and by whom?

consulting engineers' calendar

Date	Sponsor	Event	Location
Jan. 24-27	Plant Maintenance and Engineering Show	Exhibition and Conference	Int'l. Amphitheater Chicago, Ill.
Jan. 24-28	Amer. Society of Heating & Vent. Engrs.	15th International Exposition	Commercial Museum Philadelphia, Pa.
Jan. 31-Feb. 4	American Institute of Electrical Engineers	Winter Meeting	Hotel Statler New York, N. Y.
Feb. 6-11	American Society of Civil Engineers	Convention	Hotel U. S. Grant San Diego, Calif.
Feb. 14-17	American Institute of Mining Engineers	Annual Meeting	Conrad Hilton Hotel Chicago, Ill.
Feb. 21-24	American Concrete Institute	51st Annual Convention	Hotel Schroeder Milwaukee, Wis.
March 7-11	National Association of Corrosion Engineers	Annual Convention	Palmer House Chicago, Ill.
March 14-18	American Society of Tool Engineers	Western Industrial Exposition	Shrine Auditorium Los Angeles, Calif
March 20-23	American Institute of Chemical Engineers	Spring Meeting	Hotel Kentucky Louisville, Ky.
March 21-23	Southeastern Electric Exchange	Annual Meeting	Boca Raton Hotel Boca Raton, Fla.
March 23-24	American Society of Mechanical Engineers	Management Conference	Hotel Statler Cleveland, Ohio
March 28-29	American Institute of Electrical Engineers	Materials Handling Conference	Hotel Cleveland Cleveland, Ohio
March 28-April 1	American Society of Metals	Western Metal Exposition	Pan-Pacific Aud. Los Angeles, Calif.
April 18-21	American Society of Mechanical Engineers	Spring Meeting	Lord Baltimore Hotel Baltimore, Md.
May 1-4	American Institute of Chemical Engineers	National Meeting	Shamrock Hotel Houston, Texas
May 11-13	Pacific Coast Electrical Association	Annual Convention	Palace Hotel San Francisco, Calif.
May 16-20	National Materials Handling Exposition	Exposition	Int'l. Amphitheater Chicago, Ill.
May 31-June 3	3rd Basic Materials Exposition	Design Engineering Show	Convention Hall Philadelphia, Pa.
June 12-17	American Waterworks Association	Annual Conference	Chicago, Ill.
June 13-17	American Society of Civil Engineers	Convention	Jefferson Hotel St. Louis, Mo.
June 19-23	American Society of Mechanical Engineers	Semi-Annual Meeting	Hotel Statler Boston, Mass.

PROFESSIONAL LISTINGS



BOOKS

TO ORDER BOOKS

As a readers' service, CONSULTING ENGINEER will order reviewed books or any other technical volumes you need. In ordering books, give title, author, and publisher and enclose check. We will also suggest titles of books on any technical subject and order for you at regular publishers' prices.

TRANSIENT ANALYSIS OF ALTERNATING CURRENT MACHINERY by Waldo V. Lyon; Technology Press and John Wiley and Sons, Inc.; 310 pp; $7.00.

Reviewed by John C. Hitt
Project Manager
Jackson & Moreland

The electrical engineer in the consulting field will probably find this book intriguing, but difficult to use. It will interest him because it treats a-c machinery problems that arise in practice, and have been hard to answer. However, the concepts and methods provided here are not easy to master.

A new system using symmetrical components is offered for the analysis of transient conditions in a-c machinery. The common applications of symmetrical components have been in the analysis of power system problems. Such steady-state applications of the method are quite different — and considerably easier — than the type that Professor Lyon has developed.

Nevertheless, the book treats a wide variety of problems that do arise in practice. What happens to current, voltage, and torque if a squirrel-cage, wound-rotor, or synchronous motor is disconnected from the line and then reconnected? What if only two of the three stator leads are reconnected? What if there are power-factor-correction capacitors at the motor terminals? What if load torque suddenly increases? What are the transient conditions during the starting of an induction motor from a synchronous generator of comparable rating? About fifty cases of this general type are treated very specifically in the book.

This book will be of value to an engineer who encounters transient a-c machinery problems, and who is prepared to study a new and powerful — but not easy — method of attacking them.

SUCCESSFUL COMMERCIAL CHEMICAL DEVELOPMENT by H. M. Corley; John Wiley and Sons, Inc.; 374 pp; 6″ x 9″; $7.75.

Reviewed by Richard L. Moore
Assistant Treasurer
Foster D. Snell, Inc.

The purpose of the book is to cover every consideration in selecting promising new chemicals, and in rapidly developing them to the stage of economic importance. It was written by a group of men from the Commercial Chemical Development Association. Each chapter is coauthored by a veritable Who's Who in the chemical world. These men offer their wealth of practical experience in a compact up-to-date fashion.

The book has been five years in the making. The editor—H. M. Corley, secretary, General New Products Committee of Armour & Company — has kept the book out of the dry textbook category. He has made it hum with the life and vitality that characterizes the entire chemical industry itself.

From the consulting engineer's standpoint, this book is a symphony for understanding what must be considered in starting out to successfully sell a chemical. The beauty of this book is that it takes every method known to the chemical industry and pinpoints ideas. The reader can see how to price the chemical, how to advertise it, how to evaluate its toxic effects, how to estimate the patent structure, and so on. Truly, no stone is left unturned and this

book will serve many functions.

For new employees, it will be a chemical training course that only years of experience could equal. For an experienced man, it represents heretofore unpublished information in most readable style. This book should take the honors in becoming most-likely-to-be-borrowed from your bookshelf.

ENGINEERING MECHANICS by Glenn N. Cox and W. G. Plumtree; D. Van Nostrand Company, Inc.; 382 pp; $5.50.

Reviewed by Ralph W. Gretter
Department of Mechanical Engineering
Massachusetts Institute of Technology

Cox and Plumtree's *Engineering Mechanics* is an elementary text that treats the statics and dynamics of rigid bodies. A review of any new elementary text such as this by a teacher of the same subject is likely to be subjective since the material has already appeared in literally hundreds of publications. It can be new only as regards method of presentation, emphasis, scope, order, and rigorousness of coverage.

In quickly judging a new statics and dynamics text, I find it most revealing to look initially at the author's treatment of three topics, namely, friction, D'Alembert's Principle, and Coriolis' Law. Cox and Plumtree introduce friction in a manner that is calculated to give the student a clear idea of the nature of the phenomenon. Their defining equation for the coefficient of friction is given in notation which discourages unwarranted oversimplification by the student. In addition, there is a good, brief discussion of some experimental work that has been done on coefficients for various combinations of materials.

Misunderstanding of D'Alembert's Principle often stems from a vague feeling that Newton's Law and D'Alembert's Principle refer to two different phenomena of equal importance. Cox and Plumtree — by playing down the name D'Alembert, and by stressing the fact that nothing is really changed by the addition of inertia forces — do much to avoid creating these common false impressions. Their discussion of the philosophy of D'Alembert's Principle does not satisfy me. But, in fairness to the authors it must be admitted that no other available text does either.

We cannot evaluate the Cox and Plumtree approach to the problem of making Coriolis' accelerations palatable since the authors state that "motion referenced to axes that both translate and rotate is beyond the scope of this text." If the text is to be used in teaching future civil engineers only, this choice is probably perfectly satisfactory. But undergraduates in mechanical or aeronautical courses should, in my opinion, be exposed to Coriolis.

ALSO AVAILABLE

COMPRESSED AIR HANDBOOK, second edition; McGraw-Hill Company; $8.00.

Prepared by the Compressed Air and Gas Institute, this is a comprehensive and practical guide detailing the information necessary to the most efficient and economical use of compressed air power in a wide variety of industrial applications. The *Handbook* covers air and gas compressors of all types. It fully describes the use of compressed air and gas power in operating pneumatic tools, rock drills, and other air-operated devices. It covers the theory, selection, application, installation, testing, and maintenance of equipment. The *Handbook* includes extensive practical case-study information. Recent advances in all fields of compressed air power are covered in the revised and additional material featured in the book.

FILMS

COMING OUT OF THE WOODS; Timber Engineering Company; 16 mm; sound; color. This film is intended for industrial and professional audiences. It depicts modern applications of engineered timber construction ranging from homes, schools, and small industrial buildings to gigantic industrial structures covering dozens of acres.

BIBLIOGRAPHY OF MATERIALS HANDLING FILMS. This is a compilation from a survey by the American Materials Handling Society. All the films listed are devoted to industrial problems and give basic information applicable to equipment selection, methods improvement, and selling of ideas to management.

PROGRESS THROUGH CONTROLS; General Controls Co.; color; 21 minutes. The film traces the use of automatic controls through many varied uses including processing plants and the aircraft industry.

CLEAN WATER; General Electric Company; 16 mm; sound; color; 25 minutes. This is a new version of an earlier work. It is designed to create an awareness of the growing problems of stream pollution. Besides demonstrating the nationwide threat, the film prescribes remedies—industrial waste treatment and modern municipal sewage disposal plants.

consulting engineer

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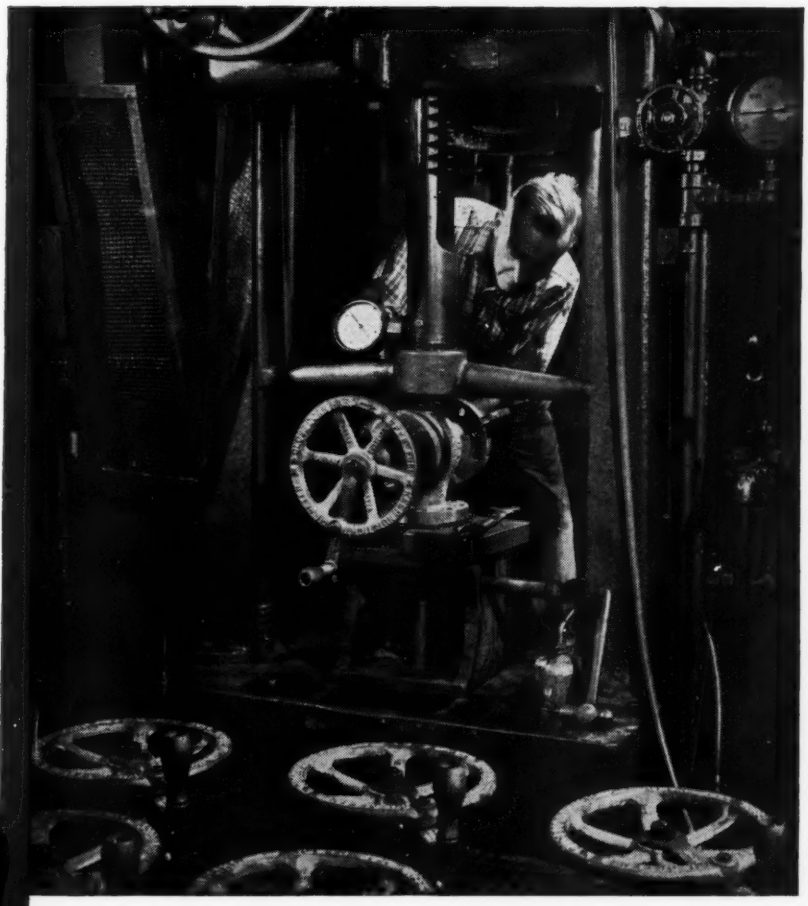

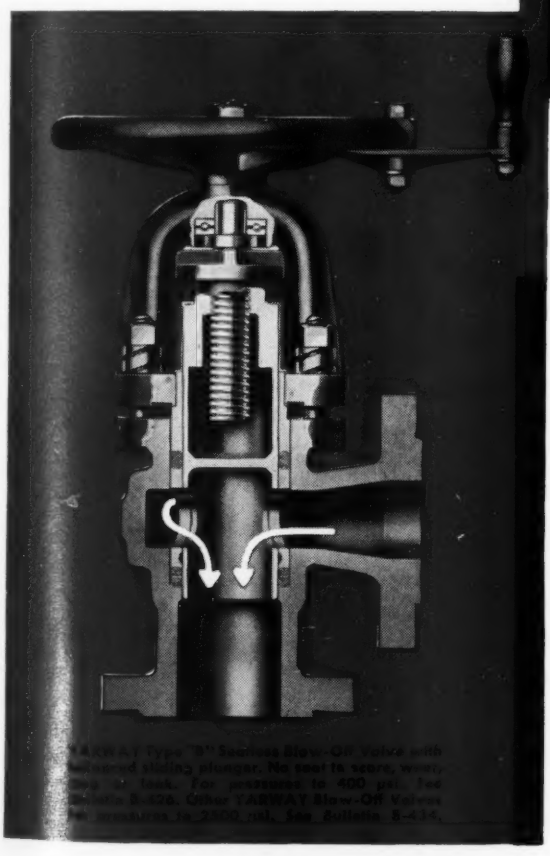

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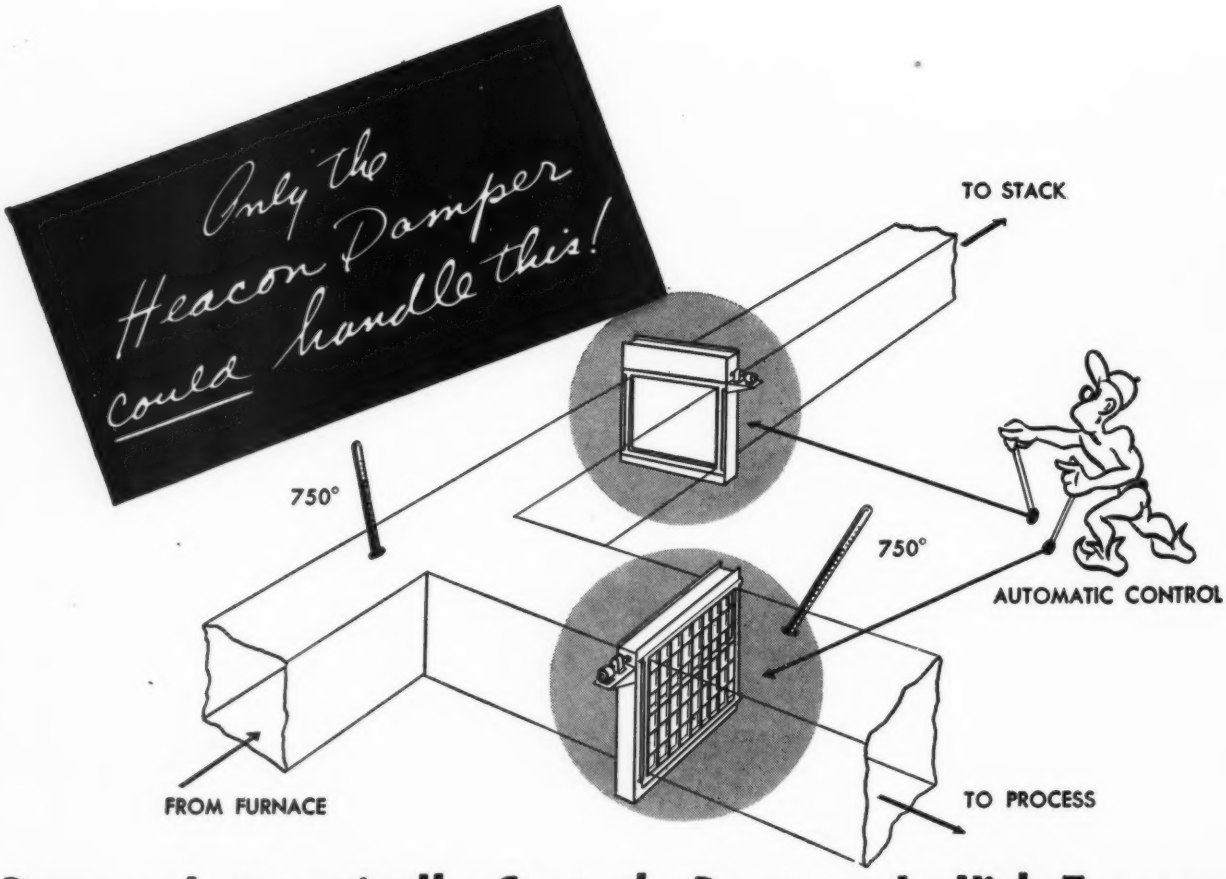

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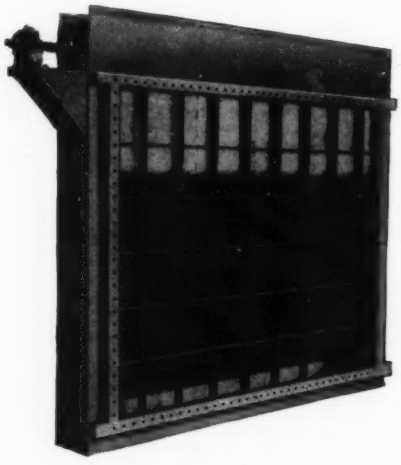

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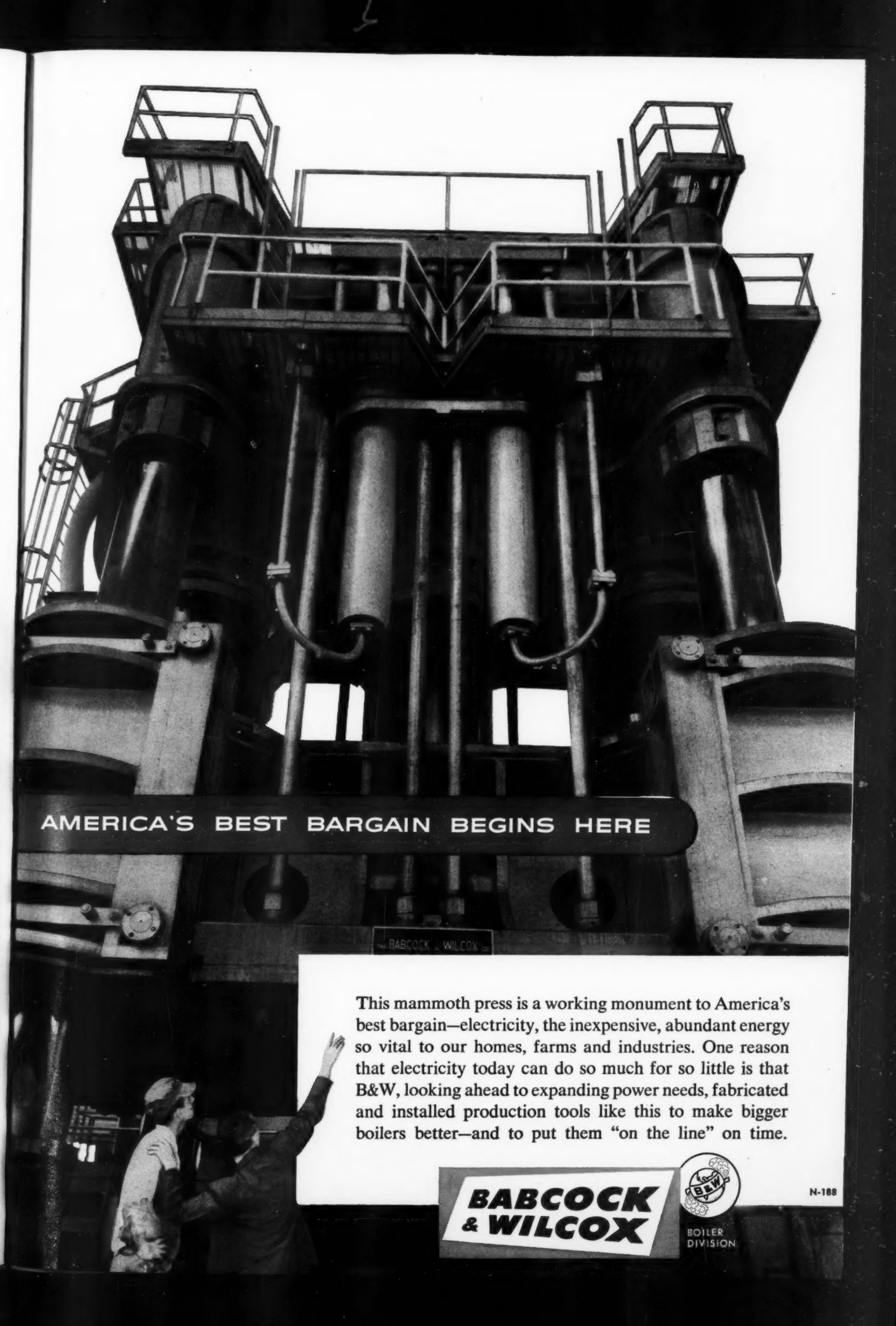

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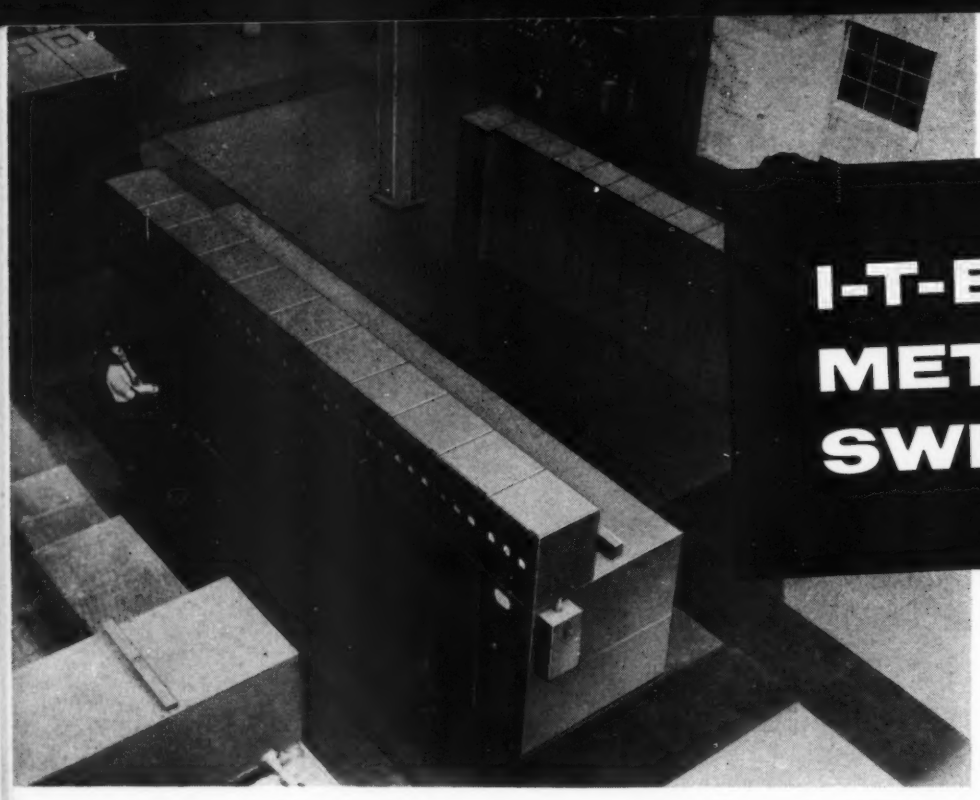

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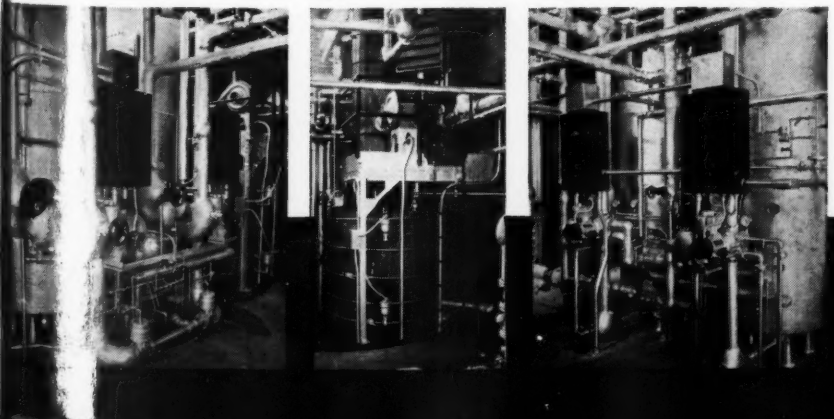

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Consider the value of Graphitization studies...

...when critical power piping is the order

This is one field where gouging pays off handsomely . . . at least when it's done by the device pictured above, a weld prober which gouges out boat-shaped samples of metal from piping that has seen lengthy service under high-temperature, high-pressure conditions.

When these samples are polished, etched, and then diagnosed under metallographic microscope their evaluation provides basic information in studies of graphitization, the phenomenon which prior to 1943 was considered of only academic interest.

Through the microscope and by means of mechanical tests Kellogg metallurgists carry on a continuous search for evidence of graphitization. They are hunting particularly for what they call the "eyebrow" or chain type of graphite. It is these malformations that cause planes of weakness in carbon steel and carbon moly power piping . . . weaknesses that can result in serious failures.

Although exactly why graphite forms is not definitely known, metallurgists have already come up with positive methods of inhibiting it. Still Kellogg specialists continue their research, endeavoring to pinpoint the exact causes of graphitization and to improve fabricating techniques and materials. More than 6,000 test pieces have been gouged out of actual service piping and evaluated by Kellogg technicians in the past decade.

Continual metallurgical research such as this graphitization program is just one of the basic reasons why any utility company obtains a valuable plus when it specifies . . . *main steam and reheat piping by Kellogg.*

* * *

New Power Piping Booklet Published . . . Send for descriptive literature about Kellogg's extensive facilities for assuring the highest quality workmanship. A section of the booklet is devoted to detailed coverage of the K-Weld* process.

OTHER FABRICATED PRODUCTS include: Pressure Vessels . . . Vacuum Vessels . . . Fractionating Columns . . . Drums and Shells . . . Heat Exchangers . . . Process Piping . . . Bends and Headers . . . Forged and Welded Fittings

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